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CIRCULAR ECONOMY IN ENTREPRENEURIAL BUSINESS MODELS: A SYSTEMATIC LITERATURE REVIEW

ECONOMIA CIRCULAR NOS MODELOS DE NEGÓCIOS EMPREENDEDORES: UMA REVISÃO SISTEMÁTICA DA LITERATURA

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ABSTRACT

This study seeks to identify emerging themes in Circular Economy (CE) among entrepreneurial models in order to advance academic research on the topic. A systematic review of the literature was conducted using Web of Science and Scopus which included 84 publications up to 2022. Next, inclusion and exclusion criteria were applied with the help of StArt (State of the Art through Systematic Review). The selected studies were then sorted into seven categories using Atlas.ti: Industrial Symbiosis, Supply Chain, Product Life Cycle, Circular Business Models, Sharing Platform, Producer-Consumer, and Product-Service Systems. The classification of these business models can result in opportunities to aid in making the energy sector more sustainable, in value creation, in the extension of product life cycles, in the reuse of raw materials. It can contribute to the study of indicators and metrics, to product design, and to waste management, and can also generate opportunities for entrepreneurs. These categories therefore can contribute to developing businesses which focus on CE, to generating opportunities for society more broadly, to institutions, and to organizations and entrepreneurs in general.

Keywords: Circular Economy; Entrepreneurship; Sustainable Entrepreneurship; Circular Business Models; Sustainability

RESUMO

O objetivo deste estudo foi identificar quais são os temas emergentes sobre EC nos modelos de negócios empreendedores para o avanço da pesquisa acadêmica sobre o tema. Foi realizada uma revisão sistemática da literatura recuperando 84 publicações até 2022 coletados na Web of Science e Scopus, e posteriormente usando critérios de inclusão e exclusão os artigos foram selecionados com o apoio do StArt (State of the Art through Systematic Review). Os estudos

selecionados foram categorizados usando o Atlas.ti. Foram identificadas sete categorias: Simbiose Industrial, Cadeia de suprimentos, Ciclo de vida do produto, Modelos de Negócios Circulares, Plataforma de compartilhamento, Produtor-consumidor, Sistemas produto-serviço. A classificação destes modelos de negócios pode resultar em oportunidades em mudança energética, criação de valor, extensão do ciclo de vida dos produtos, reaproveitamento de matérias-primas, estudo de indicadores e métricas, design de produtos, gestão de resíduos gerando oportunidades para empreendedores. Como resultado, essas categorias de negócios contribuem para o desenvolvimento de negócios empreendedores com foco na EC, gerando oportunidades para a sociedade, instituições, organizações e empreendedores em geral.

Palavras-chave: Economia Circular; Empreendedorismo; Empreendedorismo Sustentável; Modelos de Negócios Circulares; Sustentabilidade.

1 Introduction

Circular Economy (CE) is a new sustainable development strategy focused on protecting the environment and mitigating pollution (MOLINA-MORENO et al., 2017), and it proposes to dissociate economic growth from the exploitation and depletion of natural resources. This decoupling can be achieved when, in production and consumption cycles, no waste or only minimal waste is generated. To achieve this both in production and consumption, products and energy must be recycled, reused, or both (KUZMA et al., 2020).

CE is quite unlike the conventional production model which, by contrast, can be understood as a linear system. Linear systems typically rely on energy from fossil fuel and create products and materials solely for profit in a sequence of take-make-use-dispose (BOCKEN et al., 2016). According to the authors, the CE production model allows for the repeated reuse of products and materials. More efficient and sustainable products and materials are essential for today's consumer societies because they produce less greenhouse gases (GHGs), add less waste to landfills, and are not discarded so quickly (BOCKEN et al., 2016).

The linear production system is becoming unviable as it is causing the depletion of natural resources and the deterioration of ecosystems (FISCHER; PASCUCCI, 2017). Unlike linear production, EC proposes the least possible extraction and disruption to the natural environment. Then, extracted resources must be kept circulating through repeated cycles of production and consumption (SEHNEM et al., 2021).

As a competitive strategy, companies should adapt their business models to CE principles because it will improve their organizational processes while also making them more sustainable (ALMEIDA-GUZMÁN; DÍAZ-GUEVARA, 2020). For similar reasons, sustainable entrepreneurship has been identified as an effective way to help organizations adopt sustainable values and practices (SPENCE; BEN BOUBAKER GHERIB; ONDOUA BIWOLÉ, 2011; SCHAEFER; CORNER; KEARINS, 2015). By adding social and environmental values to ultimate financial objectives (DE MEDICI; RIGANTI; VIOLA, 2018), organizations can implement sustainability goals (ROK; KULIK, 2020).

According to Brendzel-Skowera (2021), CE promotes the reuse of raw materials and products to avoid generating waste and despoiling the environment with it. CE business models should therefore be studied in practice to verify whether they are being adopted, and to determine how companies are implementing them. Despite the growing knowledge drawn from research on CE in entrepreneurial models, there is a still a lack of understanding about how an organization can transition and adopt them, and this presents an opportunity for study (BRENDZEL-SKOWERA, 2021).

Studies in all areas of scientific research advance quickly and require knowledge and understanding of practices. Regarding organizational efficiency, more research into CE practices is needed to define entrepreneurial models (BRENDZEL-SKOWERA, 2021). To conduct this research, planning is required for their execution and to maintain scientific rigor so that results are reproducible (KRAUS; BREIER; DASÍ-RODRÍGUEZ, 2020).

What is more, frequent methodological and procedural follow-up on this research is necessary for these studies to be able to advance using the same parameters with which the understanding of the subject evolves. Thus, the question the present study attempts to answer is: “What themes are emerging from recent studies into CE in entrepreneurial models that can advance academic research?” To this end, the present study maps how academic research on CE relates to entrepreneurial models. This was done by a systematic literature review (SLR) to identify the CE knowledge produced in entrepreneurial models and found in recent academic literature. This study is structured as follows: after the above introduction, the second section addresses the subject´s theoretical framework; 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 sustainable development that promotes the use of resources in a more efficient and less environmentally harmful way in systems of production, distribution, and product recovery (GHISELLINI; CIALANI; ULGIATI, 2016). CE was introduced by the environmental economists Pearce and Turner (1989) when they compared the theoretical change from the linear economic system to the circular system and proposed that CE would draw from the laws of thermodynamics regarding the transformation of matter and energy (GHISELLINI; CIALANI; ULGIATI, 2016). According to Ghisellini et al. (2016), these ideas were made part of national policy in China in the attempt to transform industry and society at all levels.

CE is identified by the principle of the 3Rs: Reduce, Reuse, and Recycle (GHISELLINI; CIALANI; ULGIATI, 2016). Recycling refers to the process of recovering waste and materials after their initial use, thus limiting waste that would otherwise need to be treated and/or discarded and therefore reducing environmental impact (GHISELLINI; CIALANI; ULGIATI, 2016; KIRCHHERR; REIKE; HEKKERT, 2017). Reducing limits the use of primary energy and raw materials, and limits waste by increasing production efficiency and optimizing consumption processes. Reuse refers to recovered products or components that have not been classified as waste that can continue to be used for the same purpose for which they were originally intended (GHISELLINI; CIALANI; ULGIATI, 2016, p. 15).

CE evolved to incorporate the principles of Reduce, Reuse, and Recycle as defined by the Ellen MacArthur Foundation (EMF) such that it becomes, “an economy that provides for the restoration and eradication of waste in the productive system” (GEISSDOERFER et al., 2017; MACARTHUR, 2021a). The EMF stands out in this field for its dissemination and popularization of CE in the business community (BOCKEN et al., 2016). It has published several reports on the subject and works in collaboration with academia, public policy makers, and companies (MACARTHUR, 2021b, 2021c, 2021a).

CE promotes the minimal use of resources and energy in production cycles. This is achieved through good design, repair, reuse, remanufacturing, reconditioning, maintenance, and long-term recycling in production systems (GEISSDOERFER et al., 2017; KIRCHHERR; REIKE; HEKKERT, 2017) and can contribute to global sustainability efforts (BOCKEN et al., 2016).

CE is based on the General Systems Theory (GST) of Bertalanffy (1977) which explains the relationship between organizations and their environments. Operating in the field of Industrial Ecology (Preston 2012), it proposes the separation of the industrial system from the receiver of its 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 significant to the development of CE (MACARTHUR, 2021b, 2021c, 2021a).

Industrial metabolisms, or the physical processes of transforming raw materials and energy into finished products and waste, are important to Bocken et al. (2016) because they engage the concept of cycles. Most traditional productive systems are linear and are based on the Cradle-to-Grave concept whereas CE’s system of production proposes to be Cradle-to-Cradle. Transforming production systems allows for the achievement of sustainable and economic development for the benefit of current and future generations (KIRCHHERR; REIKE; HEKKERT, 2017).

CE can be applied at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation) (KIRCHHERR; REIKE; HEKKERT, 2017). The way businesses are structured defines their level of performance in the market, and so it follows that the performance of companies that adopt CE will be defined by this model.

Such companies can choose to slow down resource loops and encourage the long-life and reuse of products through business model innovation. They may also choose to structure their business around closing these loops such that materials are reused in manufacturing within a production facility (BOCKEN et al., 2016).

2.2 Entrepreneurship

An early 20th century academic study by the economist Schumpeter (1942) demonstrated that entrepreneurs are important for economic development as they bring innovation to the market. Schumpeter argued that the entrepreneur is the engine of economic growth and is most capable of creating new products and services. In doing so, the entrepreneur creates employment and work opportunities while increasing the productivity and competitiveness of the economy (FERREIRA; FERNANDES; KRAUS, 2019).

Since then, research on entrepreneurship has evolved from analyzing small companies to studying entrepreneurial behavior, intrapreneurship, and entrepreneurial business models to determine how these contribute to generating new jobs, to rising income, and to the implementation of new technologies. It also looks at how entrepreneurship contributes to the diversification of the economy by developing new market niches, increasing competitiveness, and allowing small companies to find new markets. It has also focused on how entrepreneurship contributes to innovation by stimulating creativity and the search for new ways to respond to the market (FERREIRA; FERNANDES; KRAUS, 2019).

New production routines, entrepreneurial behavior, intrapreneurship, and new technologies that can be used to change or improve production are some of the issues studied in entrepreneurship. As an emerging academic subject, it presents many opportunities for exploration, including important innovative ideas that seek to enhance social and economic progress (KRAUS et al., 2019). Entrepreneurship can also be simply understood as the process of creating and managing a new business (KRAUS et al., 2018a).

Shane and Venkataraman (2000, p. 218) define 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 simply being seen as a founder of new companies but can also seek and identify 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.

Entrepreneurship research has grown significantly in recent years and today includes social entrepreneurship (KRAUS et al., 2019), family entrepreneurship (KRAUS et al., 2018a), innovative entrepreneurship (KRAUS et al., 2018b), digital entrepreneurship (KRAUS; RIBEIRO-SORIANO; SCHÜSSLER, 2018), responsible or sustainable entrepreneurship (GASBARRO; RIZZI; FREY, 2017; VALLASTER et al., 2018), entrepreneurial behavior (KRAUS; MEIER; NIEMAND, 2016), and entrepreneurship and ethics (VALLASTER et al., 2019).

Entrepreneurs capture, create, and deliver value by enhancing the profitability and productivity of organizations. Sustainable entrepreneurs offer more competitive advantages to organizations (ŠEBESTOVÁ; SROKA, 2020) because by adding economic, social, and environmental value, what is called the triple bottom line (DE MEDICI; RIGANTI; VIOLA, 2018), they have greater potential for incorporating and integrating sustainability goals which offer many benefits (ROK; KULIK, 2020).

Sustainable entrepreneurs reduce unnecessary activity thus minimizing economic pressure on society and reducing impact on the environment (FRANCO; RODRIGUES, 2020) by adopting production routines that step up and narrow, and that result in slowed down resource consumption (GEISSDOERFER et al., 2017).

In recent years, entrepreneurship has been studied by researchers from various perspectives. A systematic literature review (SLR) allows progress across these studies to be verified, from its origins to the present day. The growing number of studies on entrepreneurship demonstrates that this topic has become increasingly relevant to the academic community.

3 Methodological procedures

SLR is a series of procedures that maps and evaluates existing knowledge, enabling researchers to identify a research question, topic, or phenomenon of interest, and contributes to the advancement of the field of study (TRANFIELD; DENYER; SMART, 2003). SLR has been widely used in research on CE and entrepreneurship (MERLI; PREZIOSI; ACAMPORA, 2018). SLR synthesizes existing studies according to a predefined search strategy and establishes quality criteria for each category of study (KITCHENHAM; CHARTERS, 2007). The pre-defined protocol used in the SLR in the present study 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 analyzed to determine the final set of keywords and their combinations. Only suitable keywords and combinations were used in the final search.

The following search string was used with the terms “Circular Economy” and the synonyms “Circular Economy Practices, Circularity, Life Cycle Extension, Non-linear Production, Circular Provision, Extended Product Lifecycle, Resource Recovery” and the term “Entrepreneurship” and the 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.

Figure 1 Search expression used in databases

Database	Search Expression
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"))

Source: Prepared by the authors (2023)

The next step was the selection of data sources for the study. The SLR was conducted by searching online databases. Only peer-reviewed journal articles were retrieved from academic sources to ensure transparency and replicability. The search included more than one database in order to consider the maximum number of verifiable articles. These well-establish databases are known for containing publications from journals with a relevant impact factor and for material in the field of Applied Social Sciences (KRAUS; BREIER; DASÍ-RODRÍGUEZ, 2020). The database search was carried out on April 1, 2023, and returned 767 articles. After applying several filters, this sample was reduced to 335 articles, as summarized in Figure 2.

Figure 2 Total scientific articles mapped

Terms	Search Expression	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	

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.

Figure 3 Research protocol

Search protocol	Description
Database	Web of Science (WoS) e Scopus
Publication type	Article and Peer Review
Language	English
Period	Publications until 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*)

Source: Prepared by the authors (2023)

3.2 Selection of Studies

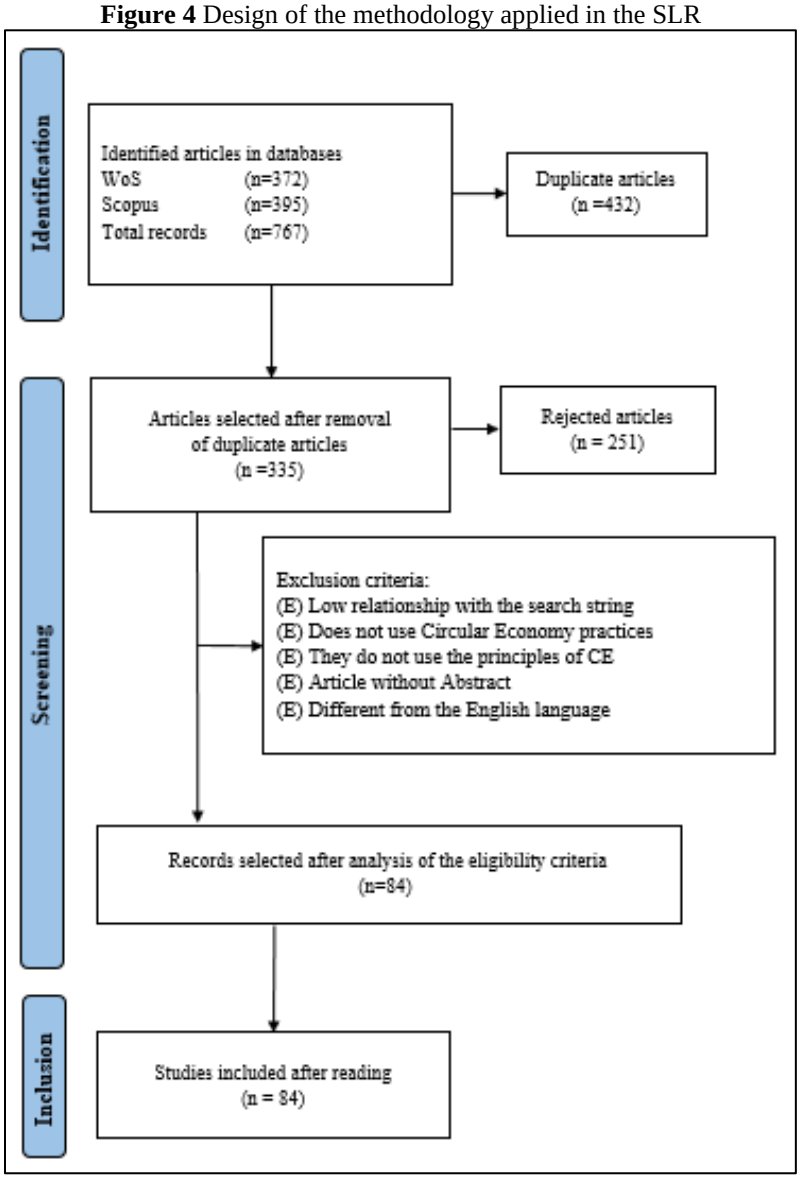
For better accuracy and handling of information, the study selection process employed the StArt tool (State of the Art through Systematic Review) as well as the SLR facilitator tool (Laboratory of Research on Software Engineering, or LAPES, 2022). The steps performed in this process were:

a) The searches in the WoS and Scopus databases resulted in a total of 767 articles according to the protocol described above. These articles were run through StArt for review and selection.
b) StArt identified 432 duplicate articles that were then excluded 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) In a language other than English.
e) In a preliminary analysis of titles, abstracts, and keywords, 84 articles met the inclusion criteria and were therefore incorporated into the sample. All articles underwent in-depth analysis with 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.

The recommendations of Tranfield et al. (2003) were applied to each of these 84 selected articles. A summary and an ID for each was entered on an Excel spreadsheet to help

identify the evolution of publications and research methodologies, and to assist with a thematic analysis of the articles and to provide suggestions for future research. Additionally, they were checked to determine whether the classification generated by StArt was effective. Figure 4 demonstrates the methodological procedures adopted in the SLR.

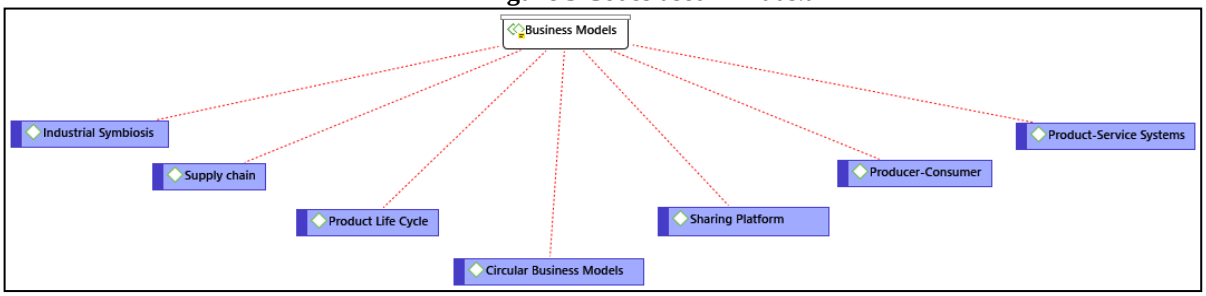
Figure 4 Design of the methodology applied in the SLR



Source: Prepared by the authors (2023)

The selected articles formed the object of this SLR, which sought to identify, evaluate, and interpret the available research related to the present topic. After selecting the studies, Atlas.ti was used to sort the articles into categories according to article content (WOODS et al., 2016). The categories in Figure 5 were defined through analysis of the articles.

Figure 5 Codes used in Atlas.ti



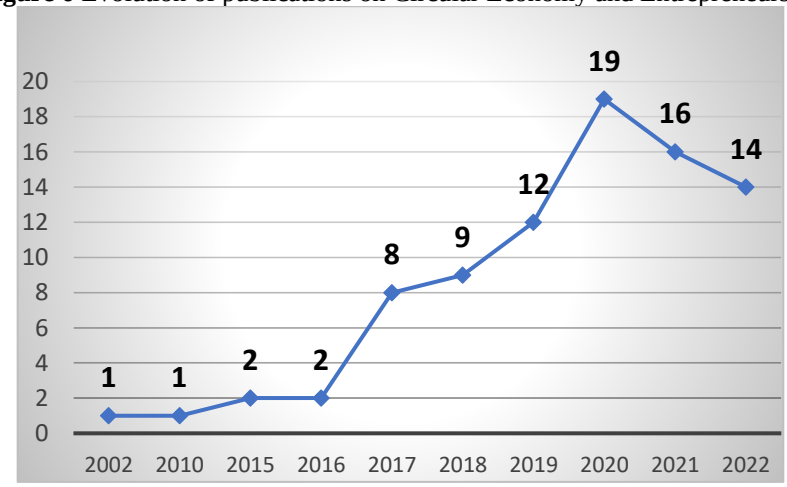
Source: Prepared by the authors (2023)

Thus, it was possible to establish relationships between the selected articles and the established categories as seen Figure 5. Based on this, an inductive analysis of article content was conducted (WOODS et al., 2016) in order to ultimately contribute to the understanding of CE phenomena in entrepreneurial models.

4 Results

Article publication dates ranged 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 and a total of just six related studies were published by 2016, representing 7% of the sample. From 2017 to 2020, there was a linear growth in the number of publications, which in numerical terms represents 57% of the sample, or 48 publications. From 2020 on, however, the rate stabilizes and decreases. In this period, 30 works were published, representing 36% of the sample. This demonstrates that this research topic has gained relevance, has been 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 has extended from its origin to reach broader areas.

Figure 6 Evolution of publications on Circular Economy and Entrepreneurship

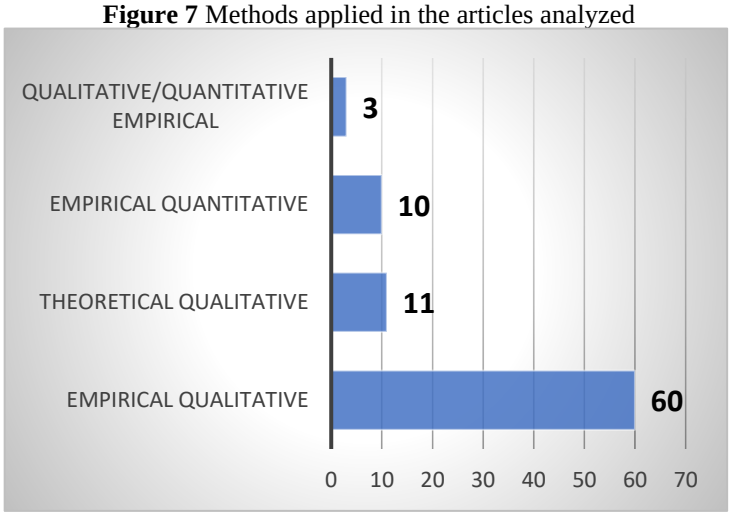


Source: Prepared by the authors (2023)

4.1 Methodological analysis of the articles

In the analysis of the 84 articles, 73 (86.9%) used empirical research methods while the remaining 11 (13.1%) used theoretical approaches. Figure 7 shows that of the 84 studies, 71 used qualitative methodologies (84.5%), ten used quantitative methodologies (11.9%), and three used mixed methodologies (3.6%).

Figure 7 Methods applied in the articles analyzed



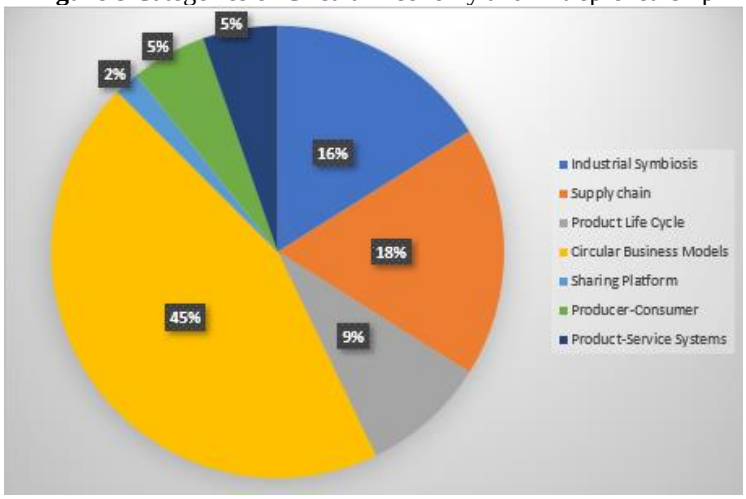
Source: Prepared by the authors (2023)

Empirical studies with a qualitative approach (n=60) predominantly used case study methods or multiple case studies with companies that employ CE. Interpretive interviews and documentary research were the main data collection techniques used by the authors in their studies and 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 analysis of the articles

Content analysis of the selected articles revealed that CE and Entrepreneurship are 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. These 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 to achieve environmental, economic, and social integration by seeking solutions dealing with raw materials, energy, water, and industrial waste in order to reduce or minimize industrial production costs. Iacondini et al. (2015) state that one option for reducing waste and increasing the reuse of industrial materials is to employ industrial

symbiosis. Zeng et al. (2021) discuss China's rapid industrialization and detail its significantly negative effects on the environment and public health due to the country's many industrial parks. According to Iacondini et al. (2015) and Zeng et al. (2021), connecting various production lines would allow private companies to achieve industrial synergy. The authors claim that industrial symbiosis is the best starting point from which to promote innovative technologies along a path to sustainable economic growth.

Sudusinghe and Seurin (2022) analyzed the collaborative practices among CE adopters in order to broadly understand the various forms of collaboration and how it can improve sustainability in interactions between supply chain partners. For Rejeb et al. (2022), using the Internet of Things (IoT) with 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 transition from a linear approach to a circular approach more easily if they move from nodal relationships to networks in which all stakeholders contribute to and gain from their relationships.

Millette et al. (2020) suggested a framework for incubators to develop skills and resources with which they can develop circular economy networks. Ferreira et al. (2021) evaluated collective strategies for competitive advantage in different sectors. Suchek et al. (2022) reviewed opportunities and internal and external factors influencing the adoption of circular business models. 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

EC promotes the recycling of materials within industrial processes and seeks added value of these materials by using them as raw materials and further inputs. Linder et al. (2015) 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 at the stages of value proposition, value creation, and delivery, as well as value capture with stakeholders.

Despeisse et al. (2017) examined emerging advanced manufacturing technologies to identify opportunities for changing the way manufacturing is organized. The authors exemplified how industrial 3D printing enables circular production systems and allows for recycled and recovered materials to be used as manufacturing inputs. As for advanced technologies, Chaudhuri et al. (2022) and Rejeb et al. (2022) stated that the authenticity of the recycled material and the ability to audit the end-to-end supply chain are guaranteed by data regarding the material's provenance that is collected and recorded on the blockchain.

Sudusinghe and Seurin (2022) found that businesses collaborating to alter the direction of the supply chain can improve sustainability. The authors stated that factors in the adoption of CE practices include external collaborative practices such as sharing responsibility for product recovery.

Suchek et al. (2022) demonstrated that both environmental commitment and green economic incentives rely on updating 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. These include deriving value from production waste and byproducts, finding platform-based solutions that improve an organization's supply chain oversight, and creating new product designs and market prospects for companies aligned with CE principles.

4.2.3 Product life cycle

In a survey carried out by Despeisse et al. (2017), the importance of CE practices to extending product life cycles was demonstrated, especially in development, remanufacturing, and repair. Kahupi et al. (2021) and Rejeb et al. (2022) highlighted customer support for sustainable innovations and the potential of IoT for recycling management. Nunes et al. (2022) focused on the role of innovative technologies in startups for improving product design, market growth, and making exclusive offers. Dantas et al. (2022) found that innovating with consumer behavioral patterns, manufacturing, distribution, and product life cycle systems accelerate the adoption of CE principles.

4.2.4 Circular Business Models

CE business models offer methods for industries to profitably increase resource productivity. Among the papers surveyed, some contribute conceptually to the definition of business models specifically regarding resource productivity and innovation (LINDER; WILLIANDER, 2015; BANSAL et al., 2020; KONIETZKO et al., 2020; ROK; KULIK, 2020; CHAUDHURI; SUBRAMANIAN; DORA, 2022). These authors investigated how companies create propositions, develop products and services that provide value to their customers, and how they capture that value through revenue and profits.

The textile industry and the electronics industry, for instance, rely heavily on natural resources and also have an adverse effect on the environment. There are opportunities for improvement here, such as in 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. Real 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) classified the business models in agribusiness (Environmental Biorefineries, Biogas Plants, Agricultural Cooperatives, Agroparks), while Viaggi (2015) analyzed the environmental performance of the agricultural sector. Nosratabadi et al. (2019) carried out a comprehensive review of CE applied to the Fashion, Health, Energy, Construction, Hospitality, and Food sectors and also to the fields of Management, Marketing, Entrepreneurship, and Supply Chain Management, among others. Palmie et al. (2021) analyzed environmental impact mitigation and transition away from fossil fuels in the electricity sector through regulatory, political, and economic contexts.

Thematic analyses have been conducted on CE business models and research trends analyzed (STAICU; POP, 2018; FERREIRA et al., 2021; FOROOZANFAR; IMANIPOUR; SAJADI, 2022; SUCHEK; FERREIRA; FERNANDES, 2022). Staicu and Pop (2018) examined stakeholders to understand the challenges in transitioning to CE. Using grounded theory, Kahupi et al. (2021) explored how competitive advantages can be created with sustainable products. Rejeb et al. (2022) investigated the role of modern technologies in facilitating the transition to CE by employing IoT. Al-Awlaqi and Aamer (2022) took a quantitative approach to determine how entrepreneurial intentions determine the adoption of CE business models.

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. From 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

CE consumption models focus on the sharing of products and services made possible by information and communication technology. Connecting consumers and suppliers by using bilateral markets makes it easier for people to obtain idle tangible goods through sharing (CURTIS; LEHNER, 2019). The authors note that these sharing platforms exclude intangible items such as services, money, time, and experience, as well as business-to-consumer transactions, used goods markets, other forms of redistribution, and exchanges that facilitate transfers of ownership. Thus, a sustainability sharing platform would encourage the sharing of products and services as well as sustainable consumption. Curtis et al. (2019) defined the sharing platform from the point of view of sustainability science, emphasizing ownership, temporary access, rivalry, and tangible goods as non-financial motivations mediated by information and communication technology.

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 concept of circularity by assessing production methods and by price comparison. Reckinger (2018) studied initiatives in Luxembourg, Belgium, that emphasize the need for collaborative effort to create a resilient food system. Sudusinghe and Searing (2022) argued that the shift from product ownership to service-based systems requires companies to focus on quality customer service, and to build trust and agility for responding to customer needs and expectations.

4.2.7 Product-service systems

Product-service systems enable the transformation of products into goods and services, but they have not been widely adopted in industry. Linder et al. (2015) studied product-service systems, while Spring et al. (2017) explored servitization and IoT technologies which offer opportunities for improved data collection, proactive maintenance, and product life-cycle control (REJEB et al., 2022).

4.3 Suggestions for future research

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

Figure 9 Recommendations for future research

Future research recommendations	Author-Data
Investigate product design concepts in CE business models.	(LINDER; WILLIANDER, 2015; DESPEISSE et al., 2017; SPRING; ARAUJO, 2017)
Check the challenges and opportunities for evolution in business models in the textile sector and in circular startups.	(TODESCHINI et al., 2017; REAL; LIZARRALDE; TYL, 2020)
Investigate the typologies of circular business models.	(CURTIS; LEHNER, 2019; DONNER; GOHIER; DE VRIES, 2020)
Examine CE practices in business models addressing consumer behavior to move them towards a sustainable economy.	(VELEVA; BODKIN, 2018)
Research the participation of women in productive processes in CE business models.	(PLÁ-JULIÁN; GUEVARA, 2019)
Research practices and production processes to extend the life of products and reduce replacement rates for new products.	(RIISGAARD; MOSGAARD; ZACHO, 2016)
Investigate innovation in circular business models.	(DANTAS; ILYAS; RITA, 2022)
Investigate Industrial Symbiosis in industrial production.	(IACONDINI et al., 2015; SUDUSINGHE; SEURING, 2022)
Examine value creation in CE business models.	(VIAGGI, 2015; CHAUDHURI; SUBRAMANIAN; DORA, 2022)
Investigate reverse logistics concepts for products in CE business models.	(FLYGANSVAER; DAHLSTROM; NYGAARD, 2019)
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.	(MURTHY; RAMAKRISHNA, 2022)
Investigate CE business models regarding energy for the improvement of industrial production.	(PALMIÉ et al., 2021)

Source: Prepared by the authors (2023)

5 Final considerations

CE strives for sustainable economic development while mitigating environmental impact through the improvement of production processes. CE reduces the use of resources and the environmental pollution that industries emit, thus preventing environmental degradation. The transition to CE will give entrepreneurs a great deal of opportunities to explore as they offer new ideas, innovate, and provide solutions for improving the economy while preserving the environment. Furthermore, it opens the door to job creation and helps to generate new markets.

This study identified the production of knowledge regarding CE and entrepreneurship that has recently been addressed in academic literature. The selected studies on this topic were classified into seven categories: CE 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 platforms (1 article). These categories can foster the development of entrepreneurship with a focus on CE by pointing out possible options for business models that organizations can consider when making efforts to become more 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 that advances theories on the adoption of CE practices in entrepreneurship.

Some limitations in this systematic literature review should be addressed in future research. First, the study identification process was centered on two academic databases, Web

of Science and Scopus, and therefore, articles not indexed here 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.

For future research, it is suggested that the role of circular startups in the adoption of CE practices be examined by comparing different geographic areas and 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 empirically explore the integration among industries regarding their use of logistics, supply chains, and production processes to reduce waste, as well as how they address production cycles to incorporate reuse and recycling.

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

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REFERENCES

AL-AWLAQI, M. A.; AAMER, A. M. Individual entrepreneurial factors affecting adoption of circular business models: An empirical study on small businesses in a highly resource-constrained economy. Journal of Cleaner Production, v. 379, p. 134736, 2022.

ALMEIDA-GUZMÁN, M.; DÍAZ-GUEVARA, C. Economía circular, una estrategia para el desarrollo sostenible. Avances en Ecuador. Estudios de la Gestión: revista internacional de administración, n. 8, p. 34–56, 2020.

BANSAL, S. et al. Attaining Circular Economy through Business Sustainability Approach: An Integrative Review and Research Agenda. Journal of Public Affairs, v. 22, n. 1, p. 1–21, 2020.

BERTALANFFY, L. V. Teoria geral dos sistemas. 3ed. ed. [s.l.] Petrópolis: Vozes, 1977.

BOCKEN, N. M. P. et al. Product Design and Business Model Strategies for a Circular Economy. Journal of Industrial and Production Engineering, v. 33, n. 5, p. 308–320, 2016.

BRENDZEL-SKOWERA, K. Circular Economy Business Models in the SME Sector. Sustainability, v. 13, n. 13, p. 7059, 2021.

CEPTUREANU, S.-I.; CEPTUREANU, E.-G.; MURSWIECK, R. G. D. Perceptions of Circular Business Models in SMEs. www.amfiteatrueconomic.ro, v. 20, n. 48, p. 310, 2018.

CHAUDHURI, A.; SUBRAMANIAN, N.; DORA, M. Circular economy and digital capabilities of SMEs for providing value to customers: Combined resource-based view and ambidexterity perspective. Journal of Business Research, v. 142, p. 32–44, 2022.

CURTIS, S. K.; LEHNER, M. Defining the Sharing Economy for Sustainability. Sustainability, v. 11, n. 3, p. 567, 2019.

DANTAS, R. M.; ILYAS, A.; RITA, J. X. Circular Entrepreneurship in Emerging Markets through the Lens of Sustainability. Journal of Open Innovation: Technology, Market, and Complexity, v. 8, n. 4, p. 211, 2022.

DE MEDICI, S.; RIGANTI, P.; VIOLA, S. Circular Economy and the Role of Universities in Urban Regeneration: The Case of Ortigia, Syracuse. Sustainability, v. 10, n. 11, p. 4305, 2018.

DESPEISSE, M. et al. Unlocking Value for a Circular Economy through 3D Printing: A Research Agenda. Technological Forecasting and Social Change, v. 115, p. 75–84, 2017.

DONNER, M.; GOHIER, R.; DE VRIES, H. A New Circular Business Model Typology for Creating Value from Agro-Waste. Science of The Total Environment, v. 716, p. 137065, 2020.

DOS-SANTOS, L. C. T. et al. Using the five sectors sustainability model to verify the relationship between circularity and sustainability. Journal of Cleaner Production, v. 366, p. 132890, 2022.

FERREIRA, J. J. et al. Prevailing theoretical approaches predicting sustainable business models: a systematic review. International Journal of Productivity and Performance Management, v. 71, n. 3, p. 790–813, 2021.

FERREIRA, J. J. M.; FERNANDES, C. I.; KRAUS, S. Entrepreneurship Research: Mapping Intellectual Structures and Research Trends. Review of Managerial Science, v. 13, n. 1, p. 181–205, 2019.

FISCHER, A.; PASCUCCI, S. Institutional Incentives in Circular Economy Transition: The Case of Material Use in the Dutch Textile Industry. Journal of Cleaner Production, Making, Buying and Collaborating for More Sustainable Production and Consumption. v. 155, p. 17–32, 2017.

FLYGANSVAER, B.; DAHLSTROM, R.; NYGAARD, A. Green innovation in recycling -a preliminary analysis of reversed logistics in Norway. World Review of Entrepreneurship Management and Sustainable Development, v. 15, p. 719–733, 2019.

FOROOZANFAR, M. H.; IMANIPOUR, N.; SAJADI, S. M. Integrating circular economy strategies and business models: a systematic literature review. Journal of Entrepreneurship in Emerging Economies, v. 14, n. 5, p. 678–700, 2022.

FRANCO, M.; RODRIGUES, M. Indicators to Measure the Performance of Sustainable Urban Entrepreneurship: An Empirical Case Study Applied to Portuguese Cities and Towns. Smart and Sustainable Built Environment, v. ahead-of-print, n. ahead-of-print, 2020. . Acesso em: 14 dez. 2021.

GASBARRO, F.; RIZZI, F.; FREY, M. Sustainable institutional entrepreneurship in practice: Insights from SMEs in the clean energy sector in Tuscany (Italy). International Journal of Entrepreneurial Behavior & Research, v. 24, n. 2, p. 476–498, 2017.

GEISSDOERFER, M. et al. The Circular Economy – A New Sustainability Paradigm? Journal of Cleaner Production, v. 143, p. 757–768, 2017.

GENNARI, F. The Transition towards a Circular Economy. A Framework for SMEs. Journal of Management and Governance, v. 27, n. 4, p. 1423–1457, 2022.

GHISELLINI, P.; CIALANI, C.; ULGIATI, S. A Review on Circular Economy: The Expected Transition to a Balanced Interplay of Environmental and Economic Systems. Journal of Cleaner Production, Towards Post Fossil Carbon Societies: Regenerative and Preventative Eco-Industrial Development. v. 114, p. 11–32, 2016.

IACONDINI, A. et al. Feasibility of Industrial Symbiosis in Italy as an Opportunity for Economic Development: Critical Success Factor Analysis, Impact and Constrains of the Specific Italian Regulations. Waste and Biomass Valorization, v. 6, n. 5, p. 865–874, 2015.

KAHUPI, I. et al. Building competitive advantage with sustainable products – A case study perspective of stakeholders. Journal of Cleaner Production, v. 289, p. 125699, 2021.

KIRCHHERR, J.; REIKE, D.; HEKKERT, M. Conceptualizing the Circular Economy: An Analysis of 114 Definitions. Resources, Conservation and Recycling, v. 127, p. 221–232, 2017.

KITCHENHAM, B.; CHARTERS, S. Guidelines for performing Systematic Literature Reviews in Software Engineering | BibSonomy. 2007. Disponível em: <https://shre.ink/UULo>. Acesso em: 3 nov. 2021.

KONIETZKO, J. et al. Circular Business Model Experimentation: Demystifying Assumptions. Journal of Cleaner Production, v. 277, p. 122596, 2020.

KRAUS, S. et al. Entrepreneurial Paths to Family Firm Performance. Journal of Business Research, v. 88, p. 382–387, 2018a.

KRAUS, S. et al. Digital Entrepreneurship: A Research Agenda on New Business Models for the Twenty-First Century. International Journal of Entrepreneurial Behavior and Research, 2018b. . Acesso em: 8 nov. 2021.

KRAUS, S. et al. Individual Entrepreneurial Orientation and Intrapreneurship in the Public Sector. International Entrepreneurship and Management Journal, v. 15, n. 4, p. 1247–1268, 2019.

KRAUS, S.; BREIER, M.; DASÍ-RODRÍGUEZ, S. The Art of Crafting a Systematic Literature Review in Entrepreneurship Research. International Entrepreneurship and Management Journal, v. 16, n. 3, p. 1023–1042, 2020.

KRAUS, S.; MEIER, F.; NIEMAND, T. Experimental Methods in Entrepreneurship Research: The Status Quo. International Journal of Entrepreneurial Behavior & Research, 2016. . Acesso em: 8 nov. 2021.

KRAUS, S.; RIBEIRO-SORIANO, D.; SCHÜSSLER, M. Fuzzy-Set Qualitative Comparative Analysis (fsQCA) in Entrepreneurship and Innovation Research – the Rise of a Method. International Entrepreneurship and Management Journal, v. 14, n. 1, p. 15–33, 2018.

KUZMA, E. L. et al. Design of the research method in circular economy: a systematic review of literature. 2020. Acesso em: 10 nov. 2021.

LABORATORY OF RESEARCH ON SOFTWARE ENGINEERING (LAPES). StArt (State of the Art through Systematic Review) São Carlos Universidade Federal de São Carlos (DC/UFSCar), 2022. Disponível em: <http://lapes.dc.ufscar.br/tools/start_tool>. Acesso em: 21 nov. 2022.

LINDER, M.; WILLIANDER, M. Circular Business Model Innovation: Inherent Uncertainties. Business Strategy and the Environment, v. 26, n. 2, p. 182–196, 2015.

MACARTHUR, E. Towards the Circular Economy: Opportunities for the consumer goods sector. Vol. 2. Disponível em: <https://shre.ink/UUL8>. Acesso em: 3 nov. 2021a.

MACARTHUR, E. Towards the Circular Economy: Accelerating the scale-up across global supply chains. Vol. 3. Disponível em: <https://shre.ink/UULx>. Acesso em: 3 nov. 2021b.

MACARTHUR, E. Towards the Circular Economy: An economic and business rationale for an accelerated transition. Vol.1. Disponível em: <https://shre.ink/UULM>. Acesso em: 3 nov. 2021c.

MERLI, R.; PREZIOSI, M.; ACAMPORA, A. How Do Scholars Approach the Circular Economy? A Systematic Literature Review. Journal of Cleaner Production, v. 178, p. 703–722, 2018.

MILLETTE, S.; EIRÍKUR HULL, C.; WILLIAMS, E. Business Incubators as Effective Tools for Driving Circular Economy. Journal of Cleaner Production, v. 266, p. 121999, 2020.

MOLINA-MORENO, V. et al. Design of Indicators of Circular Economy as Instruments for the Evaluation of Sustainability and Efficiency in Wastewater from Pig Farming Industry. Water, v. 9, n. 9, p. 653, 2017.

MURTHY, V.; RAMAKRISHNA, S. A Review on Global E-Waste Management: Urban Mining towards a Sustainable Future and Circular Economy. Sustainability, v. 14, n. 2, p. 647, 2022.

NOSRATABADI, S. et al. Sustainable Business Models: A Review. Sustainability, v. 11, n. 6, p. 1663, 2019.

NUNES, A. K. da S.; MORIOKA, S. N.; BOLIS, I. Challenges of business models for sustainability in startups. RAUSP Management Journal, v. 57, n. 4, p. 382–400, 2022.

PALMIÉ, M. et al. Startups versus incumbents in 'green' industry transformations: A comparative study of business model archetypes in the electrical power sector. Industrial Marketing Management, v. 96, p. 35–49, 2021.

PEARCE, D. W.; TURNER, R. K. Economics of Natural Resources and the Environment. [s.l.] Johns Hopkins University Press (1 december 1989), 1989.

PLÁ-JULIÁN, I.; GUEVARA, S. Is Circular Economy the Key to Transitioning towards Sustainable Development? Challenges from the Perspective of Care Ethics. Futures, v. 105, p. 67–77, 2019.

PRESTON, F. A Global Redesign? Shaping the Circular Economy. Semantic Scholar, 2012. Disponível em: <https://shre.ink/UUZP>. Acesso em: 3 nov. 2021.

REAL, M.; LIZARRALDE, I.; TYL, B. Exploring Local Business Model Development for Regional Circular Textile Transition in France. Fashion Practice, v. 12, n. 1, p. 6–33, 2020.

RECKINGER, R. Social Change for Sustainable Localised Food Sovereignty: Convergence between Prosumers and Ethical Entrepreneurs. SOCIOLOGIA DEL LAVORO, n. 152, p. 174–192, 2018.

REJEB, A. et al. The Internet of Things and the circular economy: A systematic literature review and research agenda. Journal of Cleaner Production, v. 350, p. 131439, 2022.

RIISGAARD, H.; MOSGAARD, M.; ZACHO, K. O. Local Circles in a Circular Economy – the Case of Smartphone Repair in Denmark. European Journal of Sustainable Development, v. 5, n. 1, p. 109–109, 2016.

ROK, B.; KULIK, M. Circular start-up development: the case of positive impact entrepreneurship in Poland. Corporate Governance: The International Journal of Business in Society, v. 21, n. 2, p. 339–358, 2020.

SCHAEFER, K.; CORNER, P. D.; KEARINS, K. Social, Environmental and Sustainable Entrepreneurship Research: What Is Needed for Sustainability-as-Flourishing? Organization & Environment, v. 28, n. 4, p. 394–413, 2015.

SCHUMPETER, J. A. Capitalism, Socialism and Democracy, Harper & Row. New York, 1942.

ŠEBESTOVÁ, J.; SROKA, W. Sustainable Development Goals and SMEs Decisions: Czech Republic vs. Poland. Journal of Eastern European and Central Asian Research (JEECAR), v. 7, n. 1, p. 39–50, 2020.

SEHNEM, S. et al. Sustainable management from the innovation perspective and circular economy: the native case. Revista Eletrônica de Estratégia & Negócios, v. 13, p. 77, 2021.

SHANE, S.; LOCKE, E. A.; COLLINS, C. J. Entrepreneurial Motivation. Human Resource Management Review, v. 13, n. 2, p. 257–279, 2003.

SHANE, S.; VENKATARAMAN, S. The promise of entrepreneurship as a field of research. Academy of management review, v. 25, n. 1, p. 217–226, 2000.

SPENCE, M.; BEN BOUBAKER GHERIB, J.; ONDOUA BIWOLÉ, V. Sustainable Entrepreneurship: Is Entrepreneurial Will Enough? A North–South Comparison. Journal of Business Ethics, v. 99, n. 3, p. 335–367, 2011.

SPRING, M.; ARAUJO, L. Product Biographies in Servitization and the Circular Economy. Industrial Marketing Management, v. 60, p. 126–137, 2017.

STAICU, D.; POP, O. Mapping the Interactions between the Stakeholders of the Circular Economy Ecosystem Applied to the Textile and Apparel Sector in Romania. Management & Marketing, v. 13, n. 4, p. 1190–1209, 2018.

SUCHEK, N.; FERREIRA, J. J.; FERNANDES, P. O. A Review of Entrepreneurship and Circular Economy Research: State of the Art and Future Directions. Business Strategy and the Environment, v. 31, n. 5, p. 2256–2283, 2022.

SUDUSINGHE, J. I.; SEURING, S. Supply chain collaboration and sustainability performance in circular economy: A systematic literature review. International Journal of Production Economics, v. 245, p. 108402, 2022.

TODESCHINI, B. V. et al. Innovative and Sustainable Business Models in the Fashion Industry: Entrepreneurial Drivers, Opportunities, and Challenges. Business Horizons, THE GENERATIVE POTENTIAL OF EMERGING TECHNOLOGY. v. 60, n. 6, p. 759–770, 2017.

TRANFIELD, D.; DENYER, D.; SMART, P. Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. British Journal of Management, v. 14, n. 3, p. 207–222, 2003.

VALLASTER, C. et al. Responsible Entrepreneurship: Outlining the Contingencies. International Journal of Entrepreneurial Behavior and Research, 2018. . Acesso em: 8 nov. 2021.

VALLASTER, C. et al. Ethics and Entrepreneurship: A Bibliometric Study and Literature Review. Journal of Business Research, v. 99, n. 1, p. 226–237, 2019.

VELEVA, V.; BODKIN, G. Corporate-entrepreneur collaborations to advance a circular economy. Journal of Cleaner Production, v. 188, p. 20–37, 2018.

VIAGGI, D. Research and innovation in agriculture: Beyond productivity? Bio-based and Applied Economics, v. 4, p. 279–300, 2015.

WOODS, M. et al. Advancing Qualitative Research Using Qualitative Data Analysis Software (QDAS)? Reviewing Potential Versus Practice in Published Studies Using ATLAS.Ti and NVivo, 1994–2013. Social Science Computer Review, v. 34, n. 5, p. 597–617, 2016.

ZENG, D. Z. et al. China's Green Transformation through Eco-Industrial Parks. World Development, v. 140, p. 105249, 2021.