

ARTICLE

Entrepreneurship in a circular economy: a systematic review of material cycles and business models

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Abstract

The challenge of entrepreneurship under the Circular Economy (CE) model is at an early stage of debate, in which there is little evidence of how such opportunities are developed. Considering that this process involves changes from the micro-enterprise to the macro-governmental levels, this article uses a Systematic Literature Review to analyze how the current scenario is characterized, from the correlation of quantitative aspects of the publications, the economic activities involved, and the solutions found by the enterprises through the Material Cycles and Business Models. As evidence, it is clear that entrepreneurs are faced with a complex scenario since, despite the majority of business models corresponding to closing loops demonstrating efforts to change the structural logic, there is also a need for awareness of belonging, on the part of the stakeholders, since the impact takes place in a network, and pressure for new financing formats. There is also dependence on a macro dynamic, in which government policies are shown to be a possible influence on the concentration of articles on European soil. The majority presence of the Manufacturing Industry in the results may be related to the projective scope of CE. However, the higher frequency of the Technical Cycle may be an indication of the popularization of its techniques and tools in relation to the Biological Cycle. As a contribution, the literature on CE was expanded, presenting a perspective in which the notion of the broad scenario and the micro-initiatives are integrated for the knowledge of entrepreneurship.

Keywords: Circular economy. Entrepreneurship. Business models.

Empreendedorismo na economia circular: uma revisão sistemática em ciclos de materiais e modelos de negócios

Resumo

O desafio de se empreender nos moldes da economia circular (EC) encontra-se em um estágio inicial de debate, em que há poucas evidências de como tais oportunidades são desenvolvidas. Considerando que esse processo envolve mudanças dos níveis microempresarial e macrogovernamental, este artigo analisa, por meio de uma revisão sistemática de literatura, como se caracteriza o atual cenário, com base na correlação dos aspectos quantitativos das publicações, nas atividades econômicas envolvidas e nas soluções encontradas pelos empreendimentos por intermédio dos ciclos de materiais e modelos de negócio. Como evidências, percebe-se que os empreendedores se defrontam com um cenário complexo, uma vez que, apesar da presença majoritária de modelos de negócio corresponderem a fechamentos de *loops*, demonstrando esforços para uma mudança de lógica estrutural, ocorre também a necessidade da conscientização de pertencimento por parte dos *stakeholders*, uma vez que o impacto se dá em rede, assim como a pressão por novos formatos de financiamento. Verifica-se também a dependência de uma dinâmica macro, em que as políticas de governo mostram-se como possíveis influência para a concentração de artigos em solo europeu. A presença majoritária da indústria de transformação nos resultados pode estar relacionada com o âmbito projetivo da EC, porém, a maior frequência do ciclo técnico pode ser um indicativo da popularização de suas técnicas e ferramentas em relação ao ciclo biológico. Como contribuição, expandiu-se a literatura sobre EC, que apresenta uma perspectiva em que a noção do amplo cenário e das microiniciativas se integra para o conhecimento do caminho para nela empreender.

Palavras-chave: Economia circular. Empreendedorismo. Modelos de negócios.

Emprendimiento en economía circular: una revisión sistemática en ciclos materiales y modelos de negocio

Resumen

El desafío de emprender bajo el modelo de economía circular (EC) se encuentra en una etapa temprana de debate, en la que existe poca evidencia de cómo se desarrollan dichas oportunidades. Considerando que este proceso implica cambios desde la microempresa a los niveles macrogubernamentales, este artículo analiza, a través de una revisión sistemática de la literatura, cómo se caracteriza el escenario actual, a partir de la correlación de aspectos cuantitativos de las publicaciones, las actividades económicas involucradas y las soluciones encontradas por las empresas a través de los ciclos de materiales y modelos de negocios. Como evidencia, se encuentra que los emprendedores se enfrentan a un escenario complejo, ya que, a pesar de que la mayoría de los modelos de negocio corresponden a cierres de ciclos que demuestran esfuerzos por cambiar la lógica estructural, también existe una necesidad de conciencia de pertenencia, por parte de los grupos de interés, ya que el impacto se produce en red, así como la presión por nuevos formatos de financiación. Asimismo, se constata la dependencia de una dinámica macro, en la que las políticas gubernamentales se muestran como una posible influencia para la concentración de artículos en suelo europeo. La presencia mayoritaria de la industria manufacturera en los resultados puede estar relacionada con el alcance proyectivo de la EC, sin embargo, la mayor frecuencia del ciclo técnico puede ser un indicio de la popularización de sus técnicas y herramientas en relación con el ciclo biológico. Como aporte, se amplió la literatura sobre EC, presentando una perspectiva en la que se integran la noción de escenario amplio y microiniciativas para el conocimiento de la forma de emprenderla.

Palabras clave: Economía circular. Emprendimiento. Modelos de negocio.

Article submitted on August 24, 2022 and accepted for publication on January 23, 2023.

[Translated version] Note: All quotes in English translated by this article's translator.

DOI: <https://doi.org/10.1590/1679-395120220210x>

INTRODUCTION

The system generated throughout the industrial development process has created a perception of the environment just like an infinite reservoir of resources. The pursuit of providing utility and well-being to the user through the transformation of raw materials into consumer and capital goods, under linear economic logic, does not take into account the scarcity of natural resources and the waste generated, as well as their inadequate disposal, as per Andersen (2007). According to the author, the costs reflected in market prices are only those associated with extraction and short-term value acquisition, while the real costs, such as resource depletion and poor working conditions were not counted.

According to the Ellen MacArthur Foundation (EMF, 2012), even with technological advances and efficiency in resource use, any system whose focus is on consumption, rather than restorative use, results in losses throughout the value chain. In the face of these complex sustainability challenges currently faced, the circular economy (CE) emerges as a promising approach through a paradigmatic change proposal not only regarding the mode of production but also regarding the values and logic of the dynamics that govern the current economic system.

In this discussion on how to deal with environmental changes, corporate responsibility has also gained progressive attention (United Nations Research Institute for Social Development [UNRISD], 2010). Although the circular economy is an area that is increasingly receiving attention, discussions around the implementation of this concept usually revolve around established companies (Stahel, 2016). However, considering that this is a disruptive concept, it seems that the role of established companies in driving this type of change has been possibly overstated, as they would be established under a format of compliance with the rules and culture of the current market (Michaelis, 2003). Instead, a greater opportunity may lie in the entry of new participants involved from the beginning with sustainable development (Hockerts & Wüstenhagen, 2010).

For Heshmati (2017), the literature on the relationship between entrepreneurship and the CE is in its infancy, where there is little or no evidence of how entrepreneurs discover and develop opportunities to achieve sustainability goals, thus, there are gaps in knowledge on how the process will unfold.

Considering that this is a relatively new theoretical field, this study argues that it may be relevant to examine the perspectives of scientific productions on the subject, both to understand the critical analyses already carried out on this format and to capture a more comprehensive scenario by contacting the most varied productions. Thus, a systematic literature review was the method chosen to guide the question of this research: "How is the current scenario of publications that deal with the creation of enterprises that model their solutions on the circular economy characterized?"

To this end, the correlation between the principles of the circular economy, the bibliometric aspects of the publications such as year, country and publication periodical, the main economic activities carried out, and the circular solutions proposed through material cycles and/or business models.

In the search for a comprehensive view of the field, based on a basic level of knowledge, this work aims to contribute to those who intend to start exploring the area by providing a reference of the main concepts and current state of the problems faced in the path of enterprises in the circular economy. The debate on the current state of international scientific publications can also serve as a reference for a critical and comparative analysis with the current Brazilian context.

THEORETICAL FRAMEWORK

Circular economy: emergence and concept

According to EMF (2013), it is not possible to detect the origins or any exact date or author who has defined the concept of circular economy. However, it is known that in the late 1970s, its practical application to modern economic systems and industrial processes began to gain strength. According to the same author, some schools of thought helped develop and refine the concept, such as Cradle-to-Cradle, Industrial Ecology, among others. Schools that focused on common concepts like the Product Life Cycle and Systemic Vision helped integrate sustainability into the entire product life process, according to the United Nations Environment Programme (UNEP) in 2007 (as cited in Iritani, 2017). These schools also encouraged

businesses to shift from a linear “extraction-to-disposal” model to a circular and systemic one, as noted by the Ellen MacArthur Foundation in 2012.

Considering that it was based on the work of the EMF that the term has become popular and inserted in the agenda of decision-makers in the business world, government, and academia (Komatsu, 2017), helping to disseminate the change among companies (Bocken, De Pauw, Bakker, & Grinthen, 2016). For this work, therefore, the definition established by EMF was considered:

The circular economy refers to an industrial economy that is restorative by intention. Its aim is to enable effective flows of materials, energy, labor, and information, so that natural and social capital can be rebuilt (EMF, 2013).

Three principles guide actions in EC: Principle 1 advocates for the preservation and enhancement of natural capital, with control of finite stocks and balance of renewable resource flows, allied with the idea of primarily providing utility in a virtual manner whenever possible (EMF, 2015). Principle 2 seeks to improve resource yield through the circularity of products, components, and materials, in order to optimize their utility, through the management of two cycles of processes: the technical and the biological (EMF, 2015). In this sense, two material cycles are worked on: the technical and the biological. Principle 3, on the other hand, seeks to promote the effectiveness of the system by minimizing losses and negative externalities (EMF, 2015).

Box 1 presents a synthesis of the concepts involved in Principle 2, with distinction between the technical and biological cycles.

Box 1 Conceptual synthesis of the technical and biological cycles

The **technical cycle** involves managing the inventory of finite materials and is composed of subcategories for their treatment throughout and at the end of the product’s life. These subcategories are maintenance and sharing, reuse, redistribution, remanufacturing, and finally, recycling. This circularity must respect the hierarchy of the internal loops, that is, give preference to internal loops (for example, maintenance instead of recycling), as the smaller the cycle traveled over the life of a material, the greater the reduction in costs related to raw materials, labor, energy, and capital (EMF, 2015).

The **biological cycle** encompasses renewable material flows, where renewable (biological) nutrients are mostly regenerated in the biological cycle. This cycle is composed of two subcategories: regeneration, which means the waste is transformed into a nutrient that is beneficially absorbed by the environment, and cascading nutrient use, which means making the product return to the system through recycling, resulting in new cycles, processes, and products (EMF, 2012, 2015).

Fonte: EMF (2012, 2015a).

Thus, EMF (2012) argues that the circular economy is capable of providing opportunities for innovation in the areas of product development, services, and business models, while also contributing to the maintenance and increase of natural resource stocks. This proposal represents a leap in the evolution of industry, considering the challenge of transposing the struggle for market positioning in global scale production to ensure low cost and the prevailing logic of competition and consumerism that guarantee the maintenance of the current process.

Entrepreneurial function: problem or solution?

Companies and organizations, whose actions end up generating harmful side effects to society, generally cause a large part of the social and environmental problems encountered in Brazil and worldwide. These actions do not occur in isolation, as they are part of a complex system of relationships between several institutions, both from a political-economic and cultural, educational, or individual point of view.

If today organizations are protagonists in discussions about social problems, paradoxically, they are part of the solution, in that they result from a creation process in which it is possible to work towards the pursuit of visions and empowerment with more positive impacts for society. For example, according to Genú, Gómez, and Muzzio (2018), creative solutions brought about by social entrepreneurship are cited, which enable the generation of actions in response to current socio-environmental demands.

Schumpeter (1927) defined the entrepreneurial function as innovation, that is, an activity of combining and transforming production factors, such as labor, land, and capital, into new value-added goods and services that alter the conditions of supply. He argues that entrepreneurship requires a specific type of personality and conduct that is distinct from that of the rational economic man to do so. Although entrepreneurial conduct is influenced by the context of capitalism, at the same time, it transcends it, as it is rational because it requires planning and benefits from components such as currency, science, and individual freedom. On the other hand, it is not utilitarian because it consists of autonomous impulses of conquest, struggle, and creation.

The role of entrepreneurship in solving environmental challenges is increasingly emerging as an object of debate. According to Tietenberg (2018), traditional environmental economic theory concludes that inherent market failures in the economic system not only prevent entrepreneurial action from solving environmental problems but also often motivate business behavior that is degrading to the environment.

Martinelli (2009) suggests that part of society's misunderstanding of entrepreneurship is due to the understanding that the subject's behavior is guided by fixed and maximizing principles, aimed at profit and leaving no room for innovation. Moreover, they neglect the social and cultural complexity and interaction between the agent and the context.

According to Heshmati (2017), although sustainability-oriented management literature provides limited insights on how entrepreneurship creates social and environmental opportunities in the face of market failures, different sets of specific indicators and regulations are being developed for the implementation of CE at the micro level, that is, at the business level. The difficulty of implementing studies aimed at established companies differs from those in the emerging stage, as, according to the same author, it should be considered that new ventures would have high environmental and social performance but low market participation, while established companies would currently have low environmental and social performance but high market participation.

Strategies in business models

Researchers define conventional business models as the way a company conducts its business and consider them important drivers of innovation (Bocken et al., 2016). Choosing a business model outlines the structure of the path to be built (Teece, 2010), through which the company will market its product and technology innovations (Bocken et al., 2016). In other words, the same product or technology worked on by different business models will bring different economic results. Thus, sticking to the conventional and dominant logic of business models can lead companies to lose the valuable use of an innovation (Chesbrough, 2010). Therefore, according to Teece (2010), every effort in developing new products must be associated with the definition of market strategies and value creation, or business models, because technology or products alone do not guarantee success.

Studies on circular business models (CBMs) are currently very dispersed (Komatsu, 2017). According to Bakker, Hollander, Hinte, and Zijlstra (2014), the circular strategy approach differs from the linear approach in that while the latter aims at generating profit by selling artifacts, the former proposes generating profit based on material and product flows over time.

Based on the business model structures of Bocken, Short, Rana, and Evans (2014) and Bakker et al. (2014), Bocken et al. (2016) conceptualize the key strategies that can define the architecture of a business and the respective paths to growth, as described in Box 2.

Box 2
Conceptual synthesis of strategies in business models

Business model strategies		Definition
Business model strategies to slow down		
a)	Access and performance model	Provides capacity or services to meet user needs without physical products.
b)	Extending product value	It explores the residual value of products- from manufacturing to consumers, and then back to manufacturing- or the collection of products between distinct business entities. For example, remanufacturing.
c)	Classic long-term model	These are business models focused on offering a long product life, supported, for example, by design for durability and repair.
d)	Encouraging sufficiency	It presents solutions that actively seek to reduce the final user’s consumption, through principles such as durability, upgradability, service, warranty, and repairability, and a non-consumerist marketing and sales approach.
Business model strategies for closing loops.		
e)	Extending the value of the resource	It explores the residual value of resources, by collecting and supplying “waste” material or resources to transform them into new forms of value.
f)	Industrial symbiosis	A process-oriented solution focuses on using residual outputs from one process as raw materials for another process, and benefits from the geographical proximity of companies.

Source: Developed by the authors based on Bakker et al. (2014), Bocken et al. (2016), and Bocken et al. (2014).

Bocken et al. (2016) note that the categories mentioned in Box 2 are intended to present key elements of strategies that can contribute to the formation of a circular business model. Considering that, the intention of this research is not to delve into the aspects surrounding circular models, but rather to begin clarifying the main characteristics that form their strategies; Bocken et al.’s (2016) this work will use classification as a reference.

According to the authors, the shift to a circular economy is inherently complex, and systemic thinking is essential to understand the broader impact of structuring business models on society. This statement is in line with Lovins, Braungart, and Stahel (2014), as these authors state that it is necessary to incorporate circular thinking from the beginning of the journey, involving an understanding of the systemic scope of the economic interactions of which the business initiative is a part.

SYSTEMATIC REVIEW

In this research, we used the systematic literature review method. This method follows specific stages to ensure that we obtain relevant studies related to a specific theme and avoid biases (Denyer & Tranfield, 2009). The stages of the systematic review were based on Tranfield, Denyer, and Smart (2003) and include planning, searching, screening, and extraction/synthesis/reporting.

Thus, based on the research question, “How is the current scenario of publications that deal with the creation of enterprises that model their solutions in the circular economy characterized?”, the following key terms were defined for the literature search: “circular economy” AND *entrepren**. We selected the Web of Science (WoS) and Scopus databases for the search because they have an extensive reach with publications related to the theme. In Box 3, we present the protocol used for the search in the databases, as well as the results obtained according to each database.

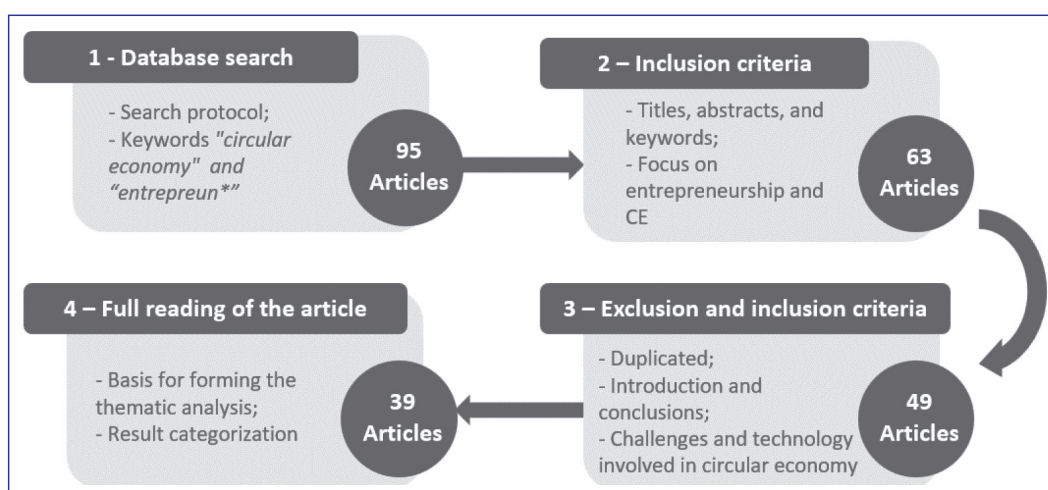
Box 3
Protocol for Database Research

Database	Selection topics	Results
Web of Science	Title; abstract; keywords; document: article; language: English.	45
Scopus	Title; abstract; keywords; document: article; language: English.	50

Source: Elaborated by the authors.

The next article screening process had August 8th, 2020 as the deadline for database search. Then, as shown in Figure 1, filter application was initiated.

Figure 1
Methodology for screening articles



Source: Elaborated by the authors based on Abidi, Leeuw, and Klumpp (2014).

In the application of filters, we based our criteria on inclusion and exclusion: Filter 1 involved checking whether the terms “circular economy” and “entrepreneurship,” along with a description of the environmental problem, economic activity, or business sector, were present in the articles’ titles, abstracts, and keywords. In Filter 2, we considered the presence of a proposal/solution presented by the enterprise as a criterion, taking into account possible particularities experienced by entrepreneurs in the solution implementation process, such as barriers and opportunities. Finally, in Filter 3, we conducted a full reading for the analysis of final data. We started the systematic literature review in July 2020 and completed it in August of that year.

During the second filter, exclusion was mainly due to subject matter not suitable for the research scope or articles that prevented a more detailed analysis of the organizational context in which entrepreneurship appeared as a secondary factor to the studied phenomena. Additionally, studies that presented a more industry-focused perspective than on organizations were also excluded.

Next, the articles were grouped, categorized, and two distinct analyses were conducted in parallel: a descriptive analysis and a thematic analysis. The descriptive analysis aimed to group standard bibliometric characteristics provided by the consulted databases, such as the year of publication, country of origin, and journal. The thematic analysis was formed by establishing categories suitable for the scenario worked in this research.

Box 4 shows a scheme of the categories used and the description of their respective classification sources.

Box 4
Categories used in the descriptive and thematic analysis

Descriptive categories	Description
Year	Publication year
Country of origin of the publication	Country of origin of the publication
Journal	Journal of publications of collected articles
Thematic categories	Description
Economic activity	Classification of economic activity according to CNAE 2.0- IBGE
Proposed solution	Tool or strategy presented that takes into account the business models of Bocken et al. (2016) and EMF material cycles (2015)

Source: Elaborated by the authors.

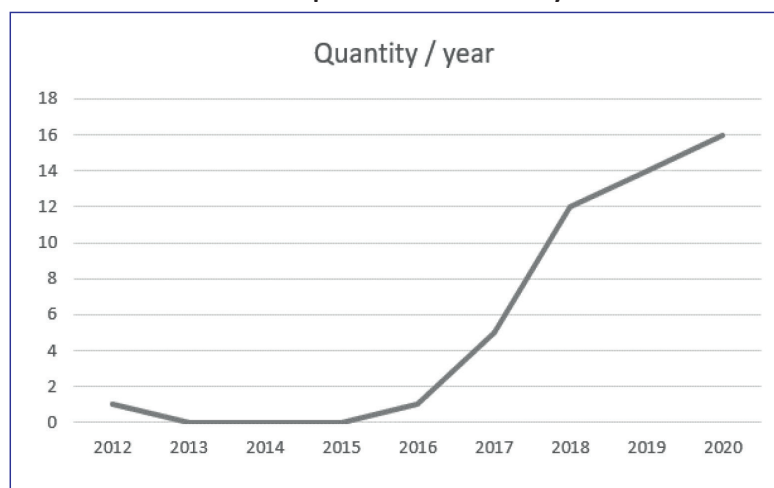
To classify the economic activity carried out by the enterprise, the National Classification of Economic Activities (CNAE 2.0) from IBGE was used, which provides a standardized basis for collecting, analyzing, and disseminating statistics related to economic activity. While this document primarily focuses on national analysis, its objective is to align the country’s classification with the changes introduced in version 4 of the International Standard Industrial Classification of All Economic Activities (CIU/ISIC), which provides a standardized classification globally and ensures consistency in this research that mainly examines the performance of foreign enterprises.

ANALYSIS AND DISCUSSION OF RESULTS

Publications over the years

The temporal interval of the articles included for review was between 2012 and 2020. However, the year 2018 stood out for the considerable increase in publication results, as well as the maintenance of this growth rate in the following years. Graph 1 outlines this progress.

Graph 1
Number of publications over the years



Source: survey data.

The first publication, dated 2012, is a Swedish article that addresses the need to transform landfills into sources of valuable materials, such as metals. To do so, it criticizes the widespread sociotechnical regime that credited landfills as a “dump” scheme and appeals for a solution originating from a creative entrepreneurial activity that could create a resource base by understanding the emerging properties of discarded materials.

The increase in publication growth from 2017 may be a consequence of the launch of the report “Towards a circular economy: a zero waste program for Europe” by the European Commission in 2014. This document pressured the European Commission to present a package of measures for the incorporation of circular guidelines on the continent by the end of 2015. Considering the political and economic representation of the European Union (EU), this fact may have generated visibility and stimulus for research in the field of CE around the world (Iwasaka, 2018).

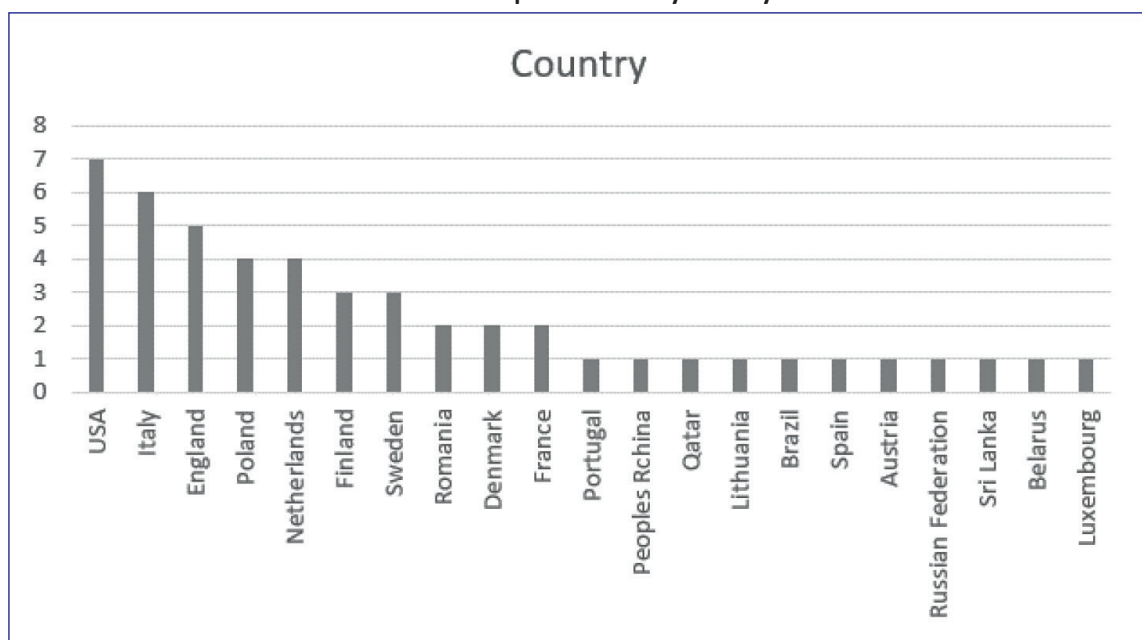
Several articles discussed the issue of the need for area sizing as a common theme. For instance, Spring and Araújo’s (2017) study revealed that processes like product qualification and processing necessitate the establishment of categories and classification regimes. The requirement for developing indexes, categories, and classification regimes is observed in the nascent phase, which encompasses discussions on entrepreneurship in CE, as described by Heshmati (2017). Since it is not feasible to implement processes or modify/create products without parameters, the establishment of measurement standards, as proposed in the above articles, appears to require significant government involvement due to the unifying and structuring nature of the initiative. However, it is important to also consider the participation of private agents, who have expertise in and closely monitor the development of their respective economic activity areas.

In the following years, the pattern of approaches by the articles is maintained, with the most commonly used methodology being case studies, which may be a demonstration of the exploratory nature of the field, but with the addition of other fields of economic activities such as agriculture, construction, financial activities, and the respective new identifications of ongoing issues.

Publications by country

The number of publications by country aimed to reflect the degree of scientific involvement of the territory in the concept of CE.

Graph 2
Number of publications by country



Source: Survey data.

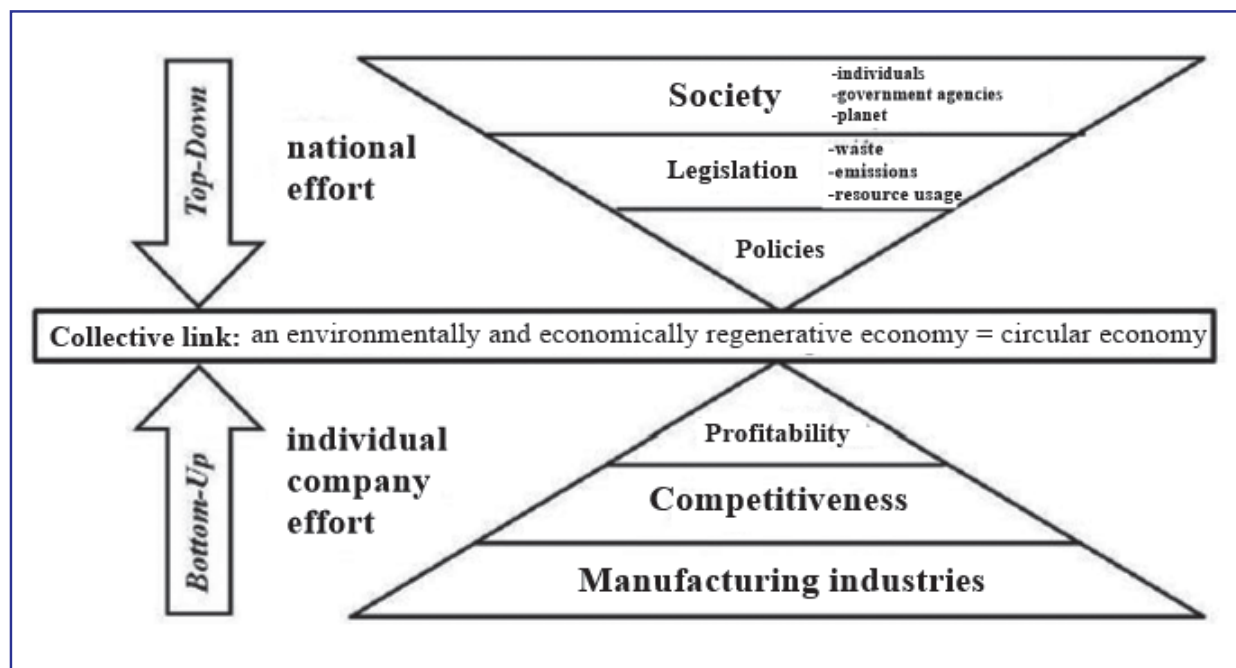
Graph 2, above, illustrates this relationship. Analyzing it, one can note that out of the 21 listed countries, 15 originate from European territory, which corresponds to approximately 71% of the total, which can be an indication of the reflection of the political initiatives reported in the previous item.

It is observed that Brazil, a member of significant position in Brics, is equivalent to two other countries in the same block: China and Russia. This may reflect its similar condition in terms of political, economic, and environmental development, which would lead it to adopt an approach more similar to these two countries regarding the proposed theme than to countries in another stage of industrial development, such as the US and Italy.

The appropriate strategy for implementing the EC must first analyze which scope of execution one wishes to achieve, that is, for a product, a company, an industrial park, a city, a region, or a country, depending on the alignment of the current circularity level with the action strategies linked to the principles of the EC (Iwasaka, 2018).

Lieder and Rashid (2016) suggest two approaches for the extensive implementation of the CE, considering the involvement of a broad spectrum of stakeholders. The first is the “top-down” approach, which involves macro-level plans driven by government agencies and legislation. The second, called the “bottom-up” approach, begins with individual and business initiatives and is primarily motivated by economic gains and competitive advantages. Thus, these two different implementation approaches were established, which vary according to the scope of action of the respective agents, as presented in Figure 2.

Figure 2
 Direction strategic for the implementation of CE



Source: Lieder and Rashid (2016) as cited in Iwasaka (2018).

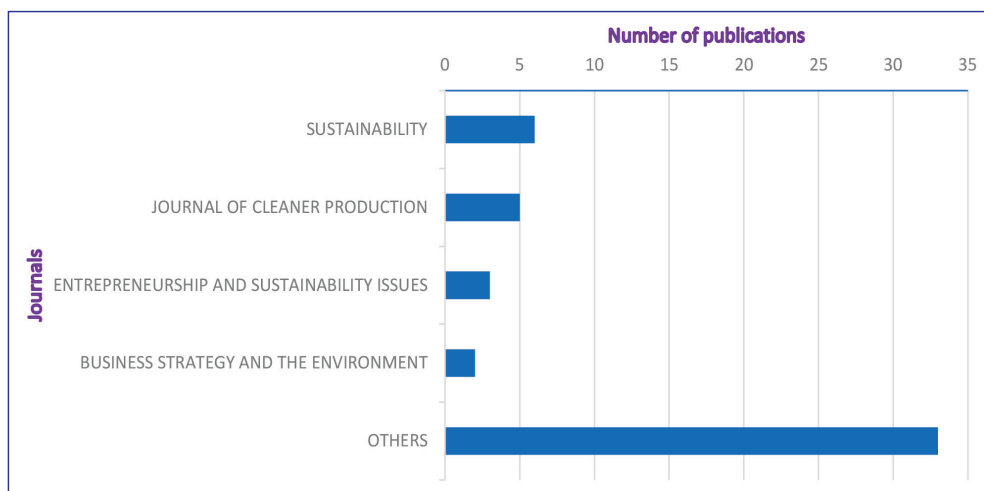
Figure 1 shows China’s position as an intriguing element to consider, given its prominence in research on the circular economy. However, when the term ‘entrepreneur*’ is added to the search for circular economy, the results markedly decrease, suggesting low adoption of the topic. Ghisellini, Cialani, and Ulgiati (2016) contend that China’s circular economy implementation stems from a national policy strategy that aims to transform the industry and socio-economic organization at all levels. This approach relies on the “command and control” mechanism, which enforces compliance through obligations and fines, in contrast to American, Japanese, and European policies that use market incentives.

Besides the Circular Economy Promotion Law enacted by the XI People’s Congress in Beijing in 2008, which was discussed earlier, other political initiatives have been implemented in the Chinese context, such as the Cleaner Production Promotion Law of 2003 and the Law on Prevention of Pollution and Control of Solid Waste of 2005 (Yuan, Bi, & Moriguichi, 2006).

Publications by journal

Out of the 37 journals analyzed, 91% of them had only one publication, which could suggest the multidisciplinary nature of the topic or a trend of increasing publications over time, making it more acceptable to a wider range of journals. Graph 3 displays the relationship between each journal and the number of published articles.

Graph 3
Number of articles by journal



Source: Survey data

In the first three journals listed in Graph 3, a multidisciplinary approach to sustainability is evident, which allows for the emergence of the relationship between circular economy and entrepreneurship to be observed.

Field of economic activity

In order to organize the areas of operation of the enterprises, each article had its economic activity area categorized, generating Box 5.

Box 5
Economic sector of activity grouped by number of articles

	CNAE	Quantity
A1	Manufacturing industries	12
A2	Agriculture, livestock, forest production, fishing and aquaculture	7
A3	Water, sewage, waste management and decontamination activities	5
A4	Professional, scientific and technical activities	4
A5	Construction	3
A6	Financial, insurance and related service activities	3
A7	Several	1
A8	Administrative activities and complementary services	1
A9	Information and communication	1
A10	Other service activities	1
A11	Extractive industries	1
	Total	39

Source: Survey data.

In the analysis of the researched papers, the manufacturing industry, an economic activity that transforms inputs and materials into new products (Brazilian Institute of Geography and Statistics [IBGE], 2007), stood out. This prevalence may be due to the alignment of this dynamic with the design principles of the CE.

The classification that ranked second in Box 5 comprises the orderly exploitation of natural resources, plants, and animals in a natural environment, involving activities such as agriculture, livestock farming, and fishing, among others (IBGE, 2007). The correlation of this section with the CE becomes evident through contemporary problems that still lack solutions, such as the use of pesticides, deforestation, monoculture, and economic production.

The analyzed articles directly address problems involving the manufacturing industry, such as strategies that include product design, the lack of sustainable packaging in the market, low rates of remanufacturing in the furniture industry, unstable products, and environmental and health risks in the use of PVC, among other barriers. These complications demonstrate the need to pay attention to circular product design at the early stage of the production process in which the manufacturing industry operates.

A common approach adopted by the articles was to distinguish legislation for each economic area involved, which may demonstrate a coherent path for the development of the circular economy. In other words, according to major legal frameworks such as the report “Towards a Circular Economy” previously explained in the section “Publications over the Years,” the issue was raised before governments and populations. Therefore, the development of the subsequent path involves specifying legislation for each economic area, generating more effective measures.

Materials cycle

Box 6 presents the results by the number of articles that addressed each material, biological, and technical cycle, and their respective internal flows.

Box 6
Materials cycle and the respective internal flows, by number of articles

Materials cycle	Qty	Technical cycle	Qty
Biological cycle	6	Recycling	9
Technical cycle	15	Remanufacturing	5
		Reuse	4
		Maintenance	3
		All	1
		Redistribution	1

Source: Survey data.

According to the data from Box 6, the technical cycle stands out in the results as the predominant approach adopted as a strategy that involves material cycles. This disparity in relation to the biological cycle may be due to the dependence on more complex technology and knowledge to achieve results in the latter. Factors such as the creation of biodegradable packaging for the market and the respective accessibility and greater diffusion of processes and knowledge that involve the technical cycle in material recycling and product repair for new uses facilitate the adoption of such measures. The fact that recycling and remanufacturing are pointed out as the most used in the technical cycle indicates that recycling can be a positive signal as a process that works with the closure of the material cycle. However, it also raises questions about whether this would not demonstrate a lack of planning of products that allow for their reuse and maintenance, as well as a lack of knowledge on the part of entrepreneurs regarding the hierarchy of material treatments representing value generation (preservation of material quality and increased profit). Considering that recycling is usually located at the outer end of technical cycles, it generally represents a high-cost process.

Business models

Of the 39 articles analyzed, only one did not address business models in its solutions. This predominance may be an indication of the relevance and applicability of this factor in this context.

Box 7 summarizes the research results for business models.

Box 7
Business models by quantity of articles

Business models	Qty	Business models – others	Qty
Extending the resource value	13	Stakeholders	7
Long-lasting classic model	7	Investments	3
Increasing product value	6		
Encouraging sufficiency	6		
Industrial symbiosis	4		
Access and performance model	3		

Source: Survey data

The definition of the business model in first place, “Extending the value of resources,” aligns with business model strategies for closing loops, meaning transforming waste into new forms of value. Examples of approaches adopted by articles under this classification include the development of nanotechnology based on metals found in landfills, aquaponics, and biogas production from waste generated in agriculture. It is worth noting that business models are not restricted to a particular material flow, but can align with both the biological and technical cycles.

Second place on the list, “Classic Long-Term Model,” fits within business model strategies to slow down the product life cycle. Examples of approaches adopted by articles under this classification include the use of 3D printers for material recovery or mapping enterprises based on remanufacturing and recycling products in a particular country.

It is noteworthy that in the aforementioned results, opportunities mostly refer to the reuse and/or repair of product value, while the issue of the “Encouraging Sufficiency” model is given little attention. This leads to reflection on the difficulty of incentivizing a reduction in final user consumption, which means that profitability is still closely associated with sales volume over time.

In ten of the analyzed studies, other topics related to business models were worked on, which did not classify in the table used by Bocken et al. (2016) but deserve mention due to their relevance in the circular business modeling process. The topics discussed in the cases include “Stakeholders,” which analyze the actors impacted by the organization’s actions and their influence on the organization’s direction, and represents seven of the cases. Another topic is “Investments,” which is present in three cases and is mainly related to new forms of investment that enable the measurement of socio-environmental impact. These new models adapt to the reality of circular SMEs that require time for research, innovation, and experimentation of various mechanisms to overcome new barriers, such as the need for speed and high financial returns.

The interests and disinterests of the parties involved are still being measured in the case of “Stakeholders” and in this new configuration of value changes in society. For example, in the work of Todeschini, Cortimiglia, Callegaro-De-Menezes & Ghezzi (2017), the pursuit of sustainability in the fashion industry involves transactions such as the resale of past collection products and second-hand items, the structuring of a reverse supply chain, and the involvement of a new segment of consumers. Staicu and Pop (2018), who also work with the fashion industry, found that weak interactions between stakeholders and a lack of a sense of belonging can result in a fragile circular ecosystem.

Entrepreneurs, therefore, face a complex scenario, as despite the majority presence of business models corresponding to closing loops, demonstrating efforts towards a structural logic change, there is also a need for stakeholder awareness and new forms of financing, as well as structuring and government incentives since the impact occurs in a network.

CONCLUSIONS

This literature review aimed to identify, organize, and analyze research on entrepreneurship and the circular economy.

The examination of 39 articles highlighted the main business model solutions and material cycles experienced by these emerging organizations, as well as the characteristics of the respective economic activities involved. The aspects covered in this review raise discussions that can contribute to the field of research in this area.

The growth in publications from 2017 seems to be a consequence of public policies adopted by Europe, demonstrating the influential power of this region. Such initiatives have had a global impact on the scientific field. However, the articles specifically address legislation for each economic area involved, which may demonstrate a coherent path for the development of this area. That is, through major legal frameworks, the subsequent development path could involve the specification of legislation for each economic area, generating more assertive measures.

The manufacturing industry, which has the highest presence of articles, demonstrates not only a direct correlation with the productive and projective scope of the circular economy but also the respective difficulties involved. These difficulties relate to the need to integrate the concern for circular product design in the early phase of the production process.

The fact that the biological cycle appears less frequently in solutions involving material cycles may indicate its dependence on more complex instruments and knowledge to achieve results. In contrast, the technical cycle's processes are currently much more accessible and popularized.

It is evident that entrepreneurs face a complex scenario. Despite the majority presence of business models corresponding to loop closures, showing efforts for a change in structural logic, the cultural factor remains a barrier to be worked on. This includes environmental awareness and stakeholder ownership, as well as the belief that environmental preservation is the opposite of economic growth, in order to enable new financing formats.

There is also a limited presence of works originating from Brazil. However, the National Solid Waste Policy (PNRS) is already a significant advancement in establishing guidelines that articulate society in general in the search for solutions for solid waste management. The richness of Brazil's natural resources and the essential role of agriculture in its economy present great opportunities for studies related to the creation of new values while maintaining the preservation of its ecosystem. Research involving the biological cycle, such as the reuse of agricultural waste or the generation of new biodegradable materials, can also be explored. Therefore, seeking references for the application of the circular economy in emerging countries can be an efficient path for research in Brazil, given the similarities of the context, such as the common urgency of measures that jointly address social, economic, and environmental problems.

The information obtained by this research corresponds to the initial stage of data collection aimed at understanding the current scenario. Entrepreneurship is embedded in a complex context that is currently under debate in contemporary society, without a precise definition or widespread consensus on its dimensions and parameters.

Some gaps were identified throughout the development of the work, which creates space for suggesting ideas for new studies. Firstly, due to the aim of this work being a preliminary survey of the field, the resulting general nature does not allow for a more in-depth analysis of the specificities of each territorial context. In addition, the research's temporal limitation can be considered a deficiency since this systematic literature review represents a snapshot of the current scenario, and changes in society have been occurring at an increasingly accelerated pace, which can impact outcome parameters and subsequent field analyses. Considering the exploratory nature of case studies, the development of the units of analysis at different rates and directions can lead to the formation of diverse characteristics not presupposed in this work.

Future studies could focus on understanding the integration of subjective aspects of the entrepreneurial process in the circular economy, analyzing specific territorial contexts, and examining the impact of technological advancements on the field.

This research is expected to contribute to bridging the gap that currently exists between the broad and current overview of the circular economy and its linkage with strategies at the micro-contextual level. With this analysis and comparison of data, it is concluded that there is still much to learn about the concepts of the circular economy and the dynamics of its application.

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