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Dynamic capabilities for overcoming circular economy barriers: a theoretical framework proposition

Capacidades dinâmicas para superação de barreiras da economia circular: proposta de um *framework* teórico

Capacidades dinámicas para superar las barreras de la economía circular: propuesta de marco teórico

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***Abstract*:** *Society faces several challenges in the transition to a circular economy. In this regard, governments and business leaders need to better understand the key barriers and develop strategies grounded in dynamic capabilities to make this transition more efficient. Therefore, this paper aims to develop a theoretical framework to relate Dynamic Capabilities (DC) to the reduction of barriers to Circular Economy (CE) implementation at the micro level, based on a systematic literature review. Specifically, the aim is to present an overview of the research, identify barriers to transitioning to the CE, the DCs needed to address these challenges, and the CE practices organizations can implement. It was found that publications on CE, barriers, and DC have been growing over the years, predominantly employing qualitative approaches and emphasizing research conducted in Europe. In addition, 12 categories of barriers, 10 of DCs, and 5 of CE practices were identified. Then, after a process of reduction and abstraction, 9 barriers (lack of consumer awareness, knowledge, R&D, qualified HR, technology, standardization; problems in product design, management and business model), 3 DCs (design and innovation, absorption and organizational) and 3 CE practices ("Rs", design and innovation and absorption) were listed to make up the theoretical framework. By understanding the research constructs, researchers can explore less-addressed barriers and DCs, enriching the research field. In practical terms, the framework can serve as a strategic diagnostic tool, helping managers identify which CDs they need to develop or improve to reduce barriers to implementing EC practices.*

Keywords: Circular economy. Barriers. Dynamic capabilities.

Resumo: A sociedade enfrenta diversos desafios na transição para a economia circular (EC). Nesse sentido, governos e empresas precisam compreender melhor as barreiras de transição e desenvolver estratégias baseadas em capacidades dinâmicas (CD) para tornar esta transição mais eficiente. Nesse sentido, este artigo tem como objetivo desenvolver um *framework* teórico por meio do método de revisão sistemática da literatura (RSL), a fim de relacionar as CD que podem auxiliar na redução das barreiras à adoção das práticas da EC, considerando o nível micro. Especificamente, pretende-se apresentar uma visão geral das pesquisas, identificar as barreiras, as CD necessárias para enfrentá-las e as práticas da EC que podem ser implementadas. Verificou-se que as publicações têm crescido ao longo dos anos, empregando abordagens predominantemente qualitativas, com destaque para pesquisas desenvolvidas na Europa. Além disso, foram identificadas 12 categorias de barreiras, 10 de CD e 5 de práticas. Após um processo de redução e abstração, foram elencadas 9 barreiras (falta de conscientização dos consumidores, conhecimento, P&D, RH qualificado, tecnologia, padronização; problemas no design do produto, na gestão e modelo de negócios), 3 CD (design e inovação, absorção e organizacional) e 3 práticas ("Rs", design e inovação e absorção) para compor o *framework* teórico. Ao compreender os constructos, pesquisadores podem explorar barreiras e CD menos abordadas, enriquecendo o campo de pesquisa. Em termos práticos, o *framework* pode atuar como uma ferramenta de diagnóstico estratégico que auxilia gestores a compreender quais CD precisam desenvolver ou aprimorar para reduzir as barreiras

à implementação de práticas da EC.

Palavras-chave: Economia circular. Barreiras. Capacidades dinâmicas.

Resumen: *La sociedad se enfrenta a diversos retos en la transición hacia una economía circular. Este artículo tiene como objetivo desarrollar un marco teórico que relacione las CD con la reducción de las barreras para la implementación de la EC a nivel micro, a partir de una revisión sistemática de la literatura. Se busca presentar una visión general de la investigación, identificar las barreras para la transición a la EC, las CD necesarias para abordar estos retos y las prácticas de EC. Se constató que las publicaciones sobre EC, barreras y CD han ido en aumento a lo largo de los años, empleando predominantemente enfoques cualitativos y haciendo hincapié en la investigación realizada en Europa. Además, se identificaron 12 categorías de barreras, 10 de CD y 5 de prácticas de EC. Luego, tras un proceso de reducción y abstracción, se enumeraron 9 barreras (falta de conocimiento del consumidor, I+D, recursos humanos cualificados, tecnología, estandarización; problemas en el diseño del producto, la gestión y el modelo de negocio), 3 DC (diseño e innovación, absorción y organización) y 3 prácticas de CE ("Rs", diseño e innovación y absorción) para conformar el marco teórico. Al comprender los constructos, los investigadores pueden explorar barreras y DC menos abordadas, enriqueciendo así el campo de investigación. En términos prácticos, el marco puede servir como herramienta de diagnóstico estratégico, ayudando a los gerentes a identificar qué CD necesitan desarrollar o mejorar para reducir las barreras a la implementación de prácticas de CE.*

Palabras clave: *Economía circular. Barreras. Capacidades dinámicas.*

Introduction

The linear production system (extraction-production-disposal) adopted by organizations has led to environmental impacts arising from the consumption of finite natural resources (Preston, 2012). The linear system does not address product-cycle recovery (Moktadir et al., 2020), creating a growing need to change society's interactions with the environment (García-Quevedo et al., 2020). In this context, the circular economy (CE) emerges as an economic system that seeks to prevent resource depletion, close energy and material cycles, and promote sustainable development (Prieto-Sandoval et al., 2019). The CE is based on business models that replace the concept of end-of-life with practices such as reduction, reuse, recycling, and material recovery (Kirchherr et al., 2017), with the goal of eliminating waste (Sehnem et al., 2022).

The CE is based on principles such as the preservation of natural capital, the replacement of fossil fuels with renewable sources, the optimization of resources through sharing, the extension of product lifespans, and the internalization of environmental externalities (Ellen MacArthur Foundation, 2013). CE can operate at three distinct levels: micro (products, companies, consumers), meso (eco-industrial parks), and macro (city, region, nation) (Prieto-Sandoval et al., 2019). At the micro level, implementing CE is challenging for companies (Govindan & Hasanagic, 2018; Jakhar et al., 2019; Ostermann et al., 2021) and involves various barriers (De Jesus & Mendonça, 2018; Galvão et al., 2020; Kirchherr et al., 2018) that hinder the transition to circular business models, such as technical, financial, regulatory, and cultural aspects. Although the literature addresses the challenges of CE, few studies explore the resources and capabilities that companies can develop or enhance to overcome the barriers hindering the transition to CE (Khan et al., 2020a, 2020b, 2021). In particular, those capabilities that enable companies to adapt to a rapidly changing environment by integrating internal and external competencies are referred to as dynamic capabilities (DC) (Teece et al., 1997), and these are fundamental to the implementation of circular practices, as already highlighted by Khan, Daddi, and Iraldo (2020b, 2020a, 2021), who pioneered the advocacy for the development of new and dynamic capabilities for the implementation of CE.

Khan, Daddi, and Iraldo (2020b) investigate the microfoundations of DC (detection, capture, and reconfiguration) through case studies, demonstrating the success of these capabilities and their

positive contribution to the implementation of CE. They also identify the key organizational capabilities and routines that support the identification and pursuit of CE opportunities. Recently, Khan, Daddi, and Iraldo (2021) assessed whether DC facilitates the implementation of CE, analyzing manufacturing firms to determine whether their organizational routines support effective implementation. Scarpellini et al. (2020) also explore the environmental DC employed to introduce CE. Despite the relevance of DC, these studies do not detail how such can be applied to overcome barriers to the implementation of circular practices.

Thus, the main objective of this paper is to develop a theoretical framework that links barriers and DC, demonstrating how DC can help overcome these barriers, and taking into account the micro-level approach of the circular economy (CE). To this end, a systematic literature review (SLR) was conducted, with the Web of Science (WOS) and Scopus databases selected due to their academic relevance. Specifically, the aim is to provide an overview of the research, identify barriers to the implementation of CE practices, and highlight DC that help to reduce these barriers by facilitating the circular transition and CE practices.

Although other systematic reviews have been conducted, they have had a narrower focus. For example, De Jesus & Mendonça (2018) identified barriers to the CE and categorized them into cultural, regulatory, market-related, and technological categories. Aloini et al. (2020) also conducted a systematic review and identified drivers and critical success factors in the context of the CE. However, no studies were found that linked barriers and DC, which constitutes one of the unique features of this article. Furthermore, the research addresses gaps in the literature and calls for further research to better understand how specific organizational skills, processes, and activities can facilitate the implementation of CE and how DC can help overcome these difficulties (Brydges, 2021). It should also be noted that, although Luttikhuis (2020) recently addressed the relationship between barriers and DC in the context of CE, the focus was not on developing a conceptual framework that relates these constructs based on an SLR. Thus, the development of a theoretical framework based on a broad SLR further strengthens the article's relevance by establishing solid connections between DC and transition barriers in CE, in line with the suggestions of Khan, Daddi, and Iraldo (2020) and Luttikhuis (2020). Furthermore, recognizing the different barriers to the adoption of CE, as well as the mechanisms (capabilities) that help reduce them, offers practical and policy implications for consultants, professionals, and policymakers, helping them to understand and encourage the transition to CE in companies and to shift the focus from predominant linear production models to sustainable and regenerative models, such as CE.

This paper is divided into five sections, including this introduction. The next section presents the methodology adopted and the procedures used in the SLR. The third section presents the results. The fourth section discusses the results and presents the theoretical framework. Finally, the conclusions, contributions, limitations, and opportunities for further research are presented.

Methodological aspects of the study

This study employs the Systematic Literature Review (SLR) method, which consists of organizing the diverse body of knowledge relevant to a specific academic inquiry (Tranfield et al., 2003). To this end, the steps proposed by Tranfield et al. (2003) were adopted, namely: (1) Planning the review, (2) Conducting the review, and (3) Reporting and disseminating the review. The following explains the steps adopted.

(i) Planning the review

In this stage, preliminary exploratory and scoping studies were conducted to assess the relevance and scope of the literature on the topic. One of the works used in this phase was Luttikhuis's (2020) master's thesis, which examined barriers and CD in the context of the circular economy (CE)

through case studies. Next, random searches were conducted in the databases Web of Science (WoS), Scopus, and Google Scholar using general terms (circular economy, barriers, resources, and capabilities) to identify studies potentially related to the topic for analysis. Subsequently, the research protocol was developed (Table 1).

Based on the exploratory searches, a foundation was established for defining the search terms, drawing on the studies by Galvão et al. (2020) for defining the CE search terms, Bezerra et al. (2020) for defining the CD search terms, and Govindan & Hasanagic (2018) for defining the barriers search terms. Two searches were conducted (Table 1): one for CE and barriers, and another for CE and DC, since, when considering the three constructs together, the number of retrieved articles was low. Thus, at the end of the two searches, the articles were grouped into a single sample.

Table 1 - **Review protocol**

Searches	***Strings***	**Boolean indicators**
1	*"determinant*" or "success factor*" or "enabling factor*" or driver* or enabler* or barrier* or challeng** AND *"circular economy" or "circular business" or circularity or "circle economy"*	-All as title -Only "Circular economy" as title -Only "Barriers" as the title -All in the topic
2	*("circular economy" or "circular business" or circularity or "circle economy")* *AND* *("Capabilit*" or "Capacit*" or "dynamic capability")*	-All as title -Only "Circular Economy" as title -Only "CD" as title -All in the topic

Source: Authors (2023)

The WoS (Web of Science) and Scopus databases were selected because, according to Wang & Waltman (2016), both offer journal classification systems. Furthermore, no specific time frame was defined for the searches. The study was conducted in January 2023 and included articles published up to December 2022.

(2) Conducting review, reporting, and dissemination

Based on the review protocol, the searches were conducted, yielding 2,056 articles (search 1) and 781 articles (search 2). Next, a filter by document type was applied, selecting only articles, early-access articles, and reviews, resulting in a sample of 1,753 articles from the two databases. Next, for sample management, these were exported to Mendeley and EndNote and grouped into a specific folder to exclude duplicates, resulting in 1,318 articles. Subsequently, after reviewing the titles and abstracts, 756 articles were excluded, leaving 562. At this point, it was found that 24 articles read during the exploratory review were not in the sample and were therefore included, bringing the total to 586 studies. The studies were then downloaded, and 15 were unavailable, leaving 571 studies. Finally, after a full review of the studies, 106 articles remained that addressed the relationship between CE and barriers, CE and DC, or all three constructs together. It is worth noting that barriers were considered in a broad sense, encompassing challenges and difficulties that limit the implementation of CE principles and practices.

The articles were then analyzed using content analysis, a flexible research method widely used in studies of library and information science (White & Marsh, 2006). An MS Excel spreadsheet was created to extract information from the articles, including year, journal, scientific methods, geographical context of the research, CE approaches (micro, meso, and macro), barrier nomenclature, sectors studied, CE practices and DC addressed. With this information, a quantitative and descriptive analysis of the results was conducted, providing an overview of the research.

Next, a thematic and inductive analysis was conducted to gather information for constructing the theoretical framework, with the aim of identifying DC practices that could help reduce barriers

and facilitate the adoption of CE practices. To assist in this process, the methodology recommended by Elo & Kyngäs (2008) for content analysis was adopted, as described below.

(i) Open coding and coding worksheets: notes were made in the texts regarding barriers, CE practices, and DC for future coding. A total of 65 different terms for barriers, 27 terms for DC, and 24 CE practices were identified.

(ii) Grouping: after entering the data into the coding spreadsheets, the constructs were grouped based on their similarities to one another and were also grouped according to the CE context (micro, meso, or macro).

(iii) Categorization: the process of grouping constructs resulted in 12 categories of barriers, 10 categories of DC, and 5 categories of CE practices. Categorization was based on similarities among the different terms.

(iv) Abstraction: this stage was the most significant, as the authors were able to abstract the information gathered and begin the process of constructing the framework. Initially, the categories related to the main constructs were defined, and a general description of each category was formulated, as suggested by Burnard (1996). This description was generated based on the content characteristics of each construct (Dey, 2003). Thus, it was possible to begin the process of interpreting the information using interpretive and inductive approaches to determine which information would be relevant to proposing the theoretical framework (Dey, 1993). In this way, we examined how the DC (internal to companies) related to the barriers (from the CE's micro-level approach), to eliminate or reduce them, thereby facilitating the adoption of circular practices. This information was essential for the development of the theoretical framework.

Results

A total of 106 articles related to CE, barriers, and DC were selected, indicating that the field has seen significant growth since 2017, with an increase in publications in subsequent years (Figure 1). The studies exhibit methodological diversity (Figure 2), with a predominance of qualitative approaches, particularly case studies, alongside a gradual increase in quantitative research. In terms of empirical application, there is a greater concentration of studies in the European context, followed by Asian countries, which reinforces the global relevance of the topic (Figure 3). Europe is characterized by its strict environmental legislation and concern for environmental issues, being one of the first regions in the world to discuss aspects related to CE.

Tables 2, 3, and 4, respectively, constitute the analytical basis for proposing the framework, allowing for the integration of the literature's findings and the construction of a theoretical structure focused on the article's objective. Table 2 presents the identified barriers, grouped by similarity, resulting in 12 categories that hinder the implementation of circular practices and the CE approaches (macro, meso, and micro) to which they relate.

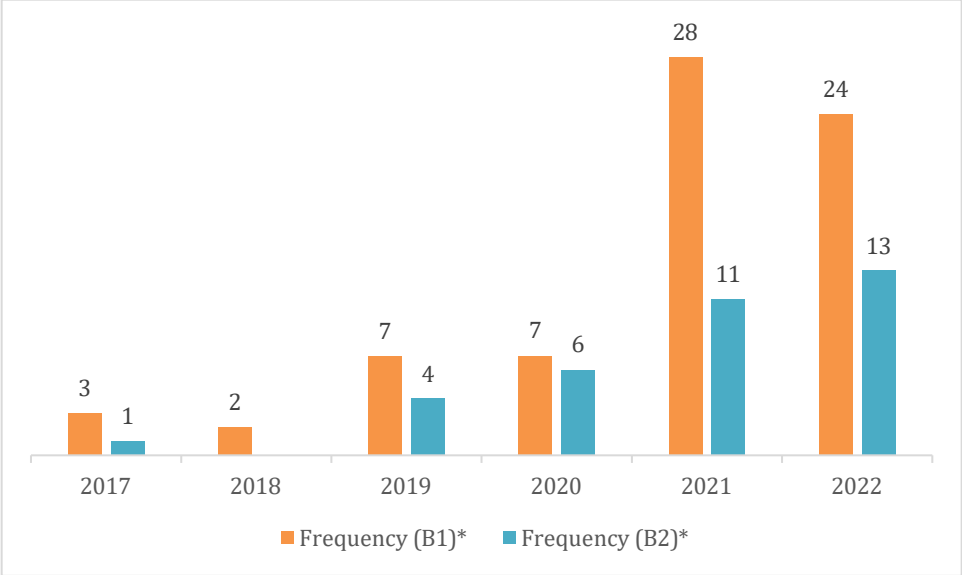

Figure 1 - **Year of publication - searches (1 and 2)**
Source: Authors (2023)
Note: *B1: Search 1, B2: Search 2.

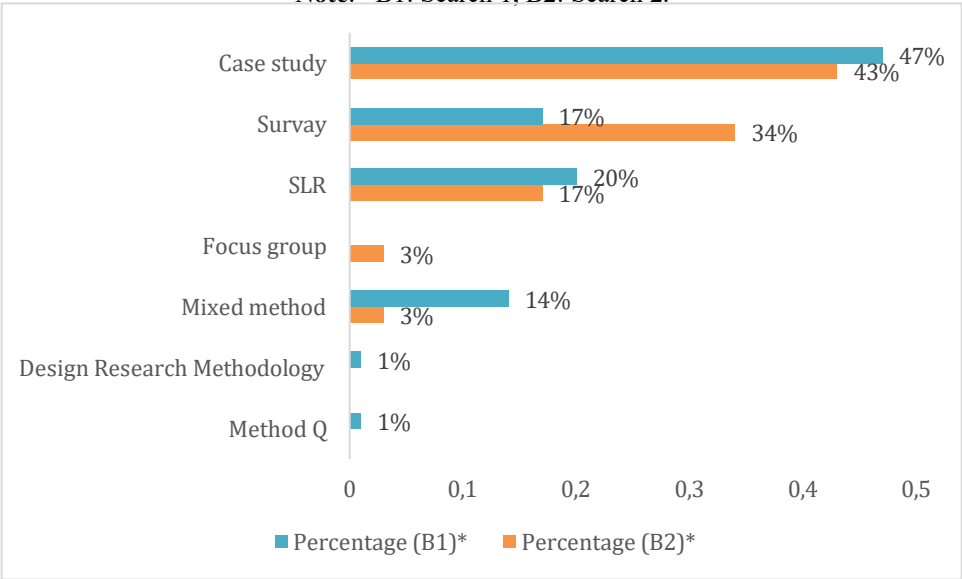

Figure 2 - **Methods used - searches (1 and 2)**
Source: Authors (2023)
Note: *B1: Search 1, B2: Search 2.

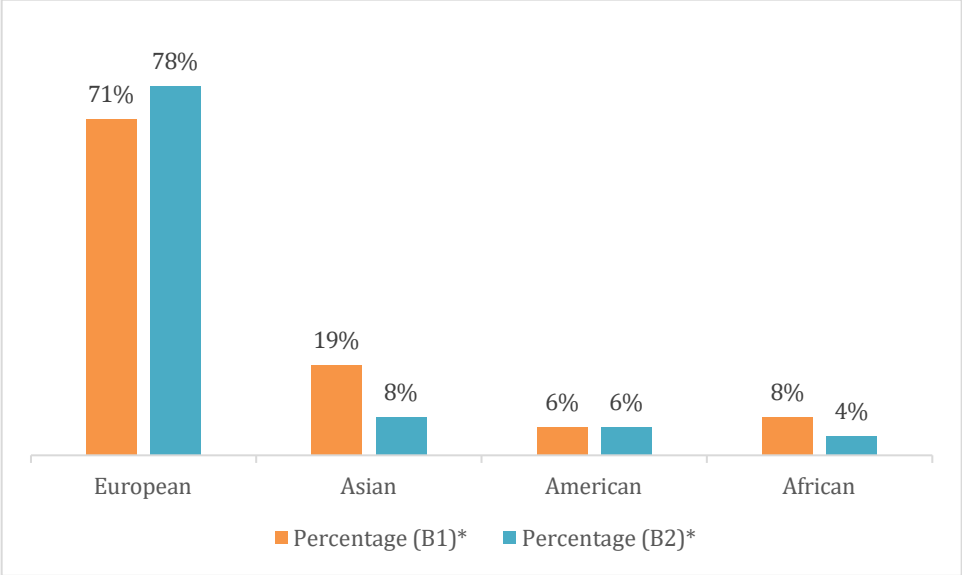

Figure 3 - **Geographic context of the empirical studies - searches (1 and 2)**
Source: Authors (2023)
Note: *B1: Search 1, B2: Search 2.

Table 2 – **Barriers to EC according to the micro, meso, and macro approaches**

Barriers	Authors	Macro	Meso	Micro	Unidentified
Lack of qualified human resources	(García-Quevedo et al., 2020)				
	(Kumar et al., 2019)				
	(Kant Hvass & Pedersen, 2019)				
	(Kumar et al., 2021)				
	(Garcés-Ayerbe et al., 2019a)				
	(De Jesus & Mendonça, 2018)				
TOTAL FOR EACH CE APPROACH		01	02	05	01
Problems with the business model	(García-Quevedo et al., 2020)				
	(Kumar et al., 2019)				
	(Garcés-Ayerbe et al., 2019a)				
	(Van Loonet al., 2021)				
	(Kant Hvass & Pedersen, 2019)				
	(Kumar et al., 2021)				
	(De Jesus & Mendonça, 2018)				
	(Salvador et al., 2020)				
	(Ada et al., 2021)				
	(Kayikci et al., 2021)				
TOTAL FOR EACH CE APPROACH		01	03	06	04
Lack of government incentives and support	(Kumar et al., 2019)				
	(Chhimwalet al., 2021)				
	(Ada et al., 2021)				
	(Stumpf et al., 2021)				
	(Kayikci et al., 2021)				

Barriers	Authors	Macro	Meso	Micro	Unidentified
	(Sehnem et al., 2022)				
TOTAL FOR EACH CE APPROACH		03	03	0	01
Lack of technology	(Kumar et al., 2019)				
	(Kumar et al., 2021)				
	(De Jesus & Mendonça, 2018)				
TOTAL FOR EACH CE APPROACH		01	01	02	01
Failure to comply with laws and regulations	(Govindan & Hasanagic, 2018)				
	(Ada et al., 2021)				
	(Dieckmann et al., 2020)				
	(Salvador et al., 2020)				
	(Stumpf et al., 2021)				
TOTAL FOR EACH CE APPROACH		02	01	0	02
Lack of knowledge	(Kumar et al., 2019)				
	(Ada et al., 2021)				
	(Droege et al., 2021)				
	(Ezeudu,2019)				
	(Govindan & Hasanagic, 2018)				
	(Chhimwal et al.,2021)				
TOTAL FOR EACH CE APPROACH		02	02	04	0
Lack of cooperation	(Ada et al., 2021)				
	(Salvador et al., 2020)				
	(KayikcI et al., 2021)				
	(Chhimwal et al., 2021)				
	(Droege et al., 2021)				
TOTAL FOR EACH CE APPROACH		02	02	0	01
Lack of consumer awareness	(Govindan & Hasanagic, 2018)				
	(Kant Hvass &PEDERSEN, 2019)				
	(Salvador et al., 2020)				
	(De Jesus & Mendonça, 2018)				
TOTAL FOR EACH CE APPROACH		01	0	02	02
Lack of standardization	(Kumar et al., 2019)				
	(Govindan & Hasanagic, 2018)				
	(Stumpf et al., 2021)				
	(Sehnem et al., 2022)				
TOTAL FOR EACH CE APPROACH		03	01	03	01
Product design issues	(Govindan & Hasanagic, 2018)				
	(De Jesus & Mendonça, 2018)				
TOTAL FOR EACH CE APPROACH		01	0	01	01
Management issues	(Govindan & Hasanagic, 2018)				
	(Sehnem et al., 2022)				
TOTAL FOR EACH CE APPROACH		02	0	02	0
Lack of R&D	(Kumar et al., 2019)				
	(Ada et al., 2021)				
TOTAL FOR EACH CE APPROACH		01	02	01	0

Barriers	Authors	Macro	Meso	Micro	Unidentified
TOTAL: 12		20	17	26	12

Source: Authors (2023)

Initially, we analyzed, among the groupings identified, how the authors classified each barrier according to the context of the research they were conducting. Thus, of the 65 barriers coded (prior to grouping and category creation), CE approaches were identified in 55 of them, with 22 classified as macro-level, 17 as meso-level, and 25 as micro-level. The authors considered some barriers according to different approaches; therefore, when adding up the barriers associated with the CE approaches, the total exceeds 65. For example, the barrier "lack of consumer awareness" focuses on consumer perception regarding reused products, considering the emotion generated when purchasing a new product, thus constituting an important barrier from the micro perspective of CE (Govindan & Hasanagic, 2018).

Table 3 lists the DC. We examined how the authors categorized them into the established groups, in line with the context of their research. As a result, 10 CD categories were created from the 27 capabilities. Next, following a thorough analysis of the literature, 20 CE-related practices were identified and coded. By grouping these practices based on similar characteristics, five distinct categories of CE practices emerged, as shown in Table 4.

Table 3 - **Identified dynamic capabilities**

Terms used in this research study	Terms used by the authors in the sample (Search 2)	Authors																																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Design and Innovation Capabilities for EC	Design Capabilities								*													*							*				
	Circular Design Capabilities																												*	*			
	Eco-design Capabilities																												*				
	Sustainable Design																												*				
	Remanufacturing Capabilities			*																													
	Innovation Capabilities												*												*		*					*	
Collaborative Skills	Collaborative Skills			*												*						*							*				
	Interpersonal Skills																										*						
	Cooperative Skills					*																								*			
Absorptive Capability for CE	Absorptive capacity																										*					*	*
	Absorptive ability		*																*														
	Assimilation capacity																															*	
	Acquisition capacity																															*	
	Information capacity																*																
	Analytical capacity																*																
Governance Capability	Governance Capacity							*																									
Organizational Capability for CE	Organizational capacity	*							*	*			*	*				*			*				*		*			*			
	Strategic capabilities												*																				
	Competitive capacity																											*					
	Transformational capacity																															*	
	Exploitation capacity																															*	
	Managerial capabilities	*								*																							
Detection Capability	Detection Capability													*																	*		

Sensory Abilities	Sensory Abilities													*																	*		
Reconfiguration Capabilities	Reconfiguration Capabilities													*																	*		
Technological Capability	Technological Capability	*											*				*			*						*							
Environmental Capability	Environmental Capacity																				*					*							
Total: 10 DC categories and 27 subcategories																																	

Source: Authors (2023)

Note: * 1:Abideen et al., 2021); 2: (Alonso-Muñoz et al., 2021); 3: (S. Bag & Pretorius, 2020); 4: (Surajit Bag & Rahman, 2021); 5: (Berardi & Brito, 2021); 6: (Chari et al., 2022); 7: (Ddiba et al., 2020b); 8: (De los Rios & Charnley, 2017b); 9: (Eikelenboom & de Jong, 2021); 10: (Elfany Reis do Nascimento Lopes et al., 2021); 11: (Hofmann & Jaeger-Erben, 2020); 12: (Iacovidou, Hahldakis, et al., 2021); 13: (Khan et al., 2021); 14:(Khan et al., 2020b); 15: (Köhler et al., 2022); 16:(Kristoffersen et al., 2021); 17: (Marrucci et al., 2022); 18: (Marrucci et al., 2021); 19: (Nayal et al., 2021); 20: (Pieroni et al., 2021); 21: (Prieto-Sandoval et al., 2019b); 22: (Roos Lindgreen et al., 2022); 23: (Sandberg & Hultberg, 2021); 24: (Scarpellini, Valero-Gil, et al., 2020); 25: (Sehnem & Pereira, 2019); 26: (Sehnem et al., 2022b); 27: (Ünal & Shao, 2019); 28: (Valve et al., 2021) 29: (Vihma & Moora, 2020); 30: (Wade et al., 2022); 31: (Zapata-Cantu et al., 2020); 32: (Marrucci et al., 2021).

Table 4 - **Circular Economy Practices**

EC Practices		**Authors***																
Terms used in this research study (CATEGORIES)	**Terms used by the authors in the sample**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
"Rs" practices	Recycling	*		*	*	*	*		*	*		*				*		9
	Reuse				*	*	*		*	*		*				*		7
	Remanufacturing		*	*				*		*		*			*	*		7
	Recovery							*		*								2
	Resources							*									*	2
	3R (reduce, recycle, reuse)						*		*			*	*			*		5
	4R (3Rs plus resources)								*							*		2
Design and Innovation Practices for CE	Design practices																*	1
	Ecosystem design		*	*				*		*		*			*	*		7
	Cradle to Cradle design															*		1
	Eco-innovation														*			1

EC Practices		Authors*																
	Innovation								*									1
	R&D									*								1
Best Practices for EC	Market Research									*								1
	Understanding Customer Needs									*								1
Collaborative Practices for CE	Industrial Symbiosis		*	*				*		*		*				*	*	*	8
	Eco-industrial Parks												*						1
Management Practices for CE	Waste Management						*			*		*				*			4
	Resource Management							*											1
	Environmental Management System (EMS)						*	*	*		*								4
Total: 5 categories and 20 subcategories of EC practices																			

Source: Authors (2023)

Note:*1: (Alvarez-Risco et al., 2021); 2: (Surajit Bag & Rahman, 2021); 3: (Calicchio Berardi & Peregrino de Brito, 2021) 4: (Corral-Marfil et al., 2021); 5: (Dagevos & de Lauwere, 2021); 6: (de Mattos & de Albuquerque, 2018); 7: (Ddiba et al., 2020b); 8: (Eikelenboom & de Jong, 2021); 9: (Iacovidou, Hahladakis, et al., 2021b); 10: (Khan et al., 2021);11: (Nayal et al., 2021); 12: (Scarpellini, Valero-Gil, et al., 2020); 13: (Prieto-Sandoval et al., 2019b); 14:(Sehnem et al., 2022b); 15: (Ünal & Shao, 2019); 16: (Vihma & Moora, 2020).

Discussion: Relating constructs and proposing a framework

To develop a theoretical framework, it was first necessary to identify the barriers to the transition to CE. Thus, within the 12 categories of barriers identified, the authors determined which EC approach (meso, macro, or micro) was predominant. For example, regarding the barrier "lack of qualified human resources" the authors classified it as a macro, meso, and micro approach (Table 2); however, most authors considered it a micro approach to CE, and it was therefore included in the development of the theoretical framework. Following this logic, the majority of authors in the sample identified nine barriers as representing the micro level of the CE. Thus, the following were included in the framework: lack of consumer awareness, lack of knowledge, lack of R&D, lack of qualified human resources, lack of technology, lack of standardization, product design issues, management issues, and business model issues.

The lack of government incentives and support, as well as the absence or non-enforcement of laws and regulations, were not selected because they refer to systemic and structural issues on a broader scale—often at the national level (macro level) —that affect the adoption of CE practices (Chhimwal et al., 2021; Sehnem et al., 2022; Stumpf et al., 2021). Lack of collaboration was also not selected, as it addresses the need for broad and coordinated cooperation among various stakeholders to create an environment conducive to the adoption of circular practices (meso level) (Droege et al., 2021; Salvador et al., 2020).

After identifying the barriers, the next step was to select the DC to form the framework. It is worth noting that the purpose is to explore internal capabilities related to specific types, such as absorptive capacity, which refers to the ability to assimilate value and utilize knowledge (Marrucci et al., 2021). Thus, of the 10 DC categories, three capabilities proved relevant for overcoming obstacles and for implementing CE. These are: design and innovation capability, absorption capability, and organizational capability. The capability for design and innovation encompasses the development of products and new business models that reduce environmental impact through innovation, which consists of a company's ability to assimilate knowledge into routine innovation activities (Prieto-Sandoval et al., 2019).

Organizational capability develops concrete solutions for implementing sustainable consumption, integrating its principles into the organization's strategy and product development process (Vihma & Moora, 2020). Finally, the absorption capability significantly facilitates the implementation of CE by strengthening the organizational skills required for knowledge management, which is fundamental for organizations to innovate (innovation capacity) and develop new products and processes (Sehnem et al., 2022). Thus, the selected capabilities relate to organizations' ability to purposefully adapt to their existing resource base, the dynamism of the environment (Teece et al., 1997), and to leverage different value resources in an agile manner (Teece, 2007).

Collaborative capability was not selected because it refers to the ability that organizations need to develop in conjunction with external partners, which does not fit within the scope of this research (i.e., it focuses on the meso-level approach to CE). Governance capability was not considered, as it pertains to governance for adopting circularity in the recovery of resources from urban organic waste streams (Ddiba et al., 2020), that is, a macro approach to CE. Environmental capability was also not considered, as it focuses on the analysis and evaluation of formal and informal environmental management systems, such as certification standards and other environmental management and accounting procedures (Scarpellini et al., 2020), which characterizes a macro approach to CE. Furthermore, technological capability, responsible for the development, integration, and administration of technologies for organizational advancement (Barros & Gohr, 2022), was also

not considered, as it relates, among the articles in the sample, to the analysis of the benefits of technology in circular supply chains (a meso-level approach to CE) and not to a capability related to the internal aspects of an organization (Nayal et al., 2021).

Finally, the next step was to select the CE practices to compose the framework. The first category in Table 4, "Rs," was selected because it encompasses a range of approaches. Many authors mention individual practices adopted by organizations, such as remanufacturing and recycling. On the other hand, some authors refer to the 3Rs (reduce, reuse, and recycle) (de Mattos & de Albuquerque, 2018) or even the 4Rs (Ünal & Shao, 2019). Within this category, the practice of recycling stands out, with nine articles citing it. Recycling is understood as a process in which components are disassembled, and parts or materials are separated to create new products (Harmsen et al., 2021). Reuse is also highlighted in seven articles, where it is described as the circular practice of repairing and reselling secondhand items (Harmsen et al., 2021). Remanufacturing, mentioned in five articles, is also highlighted, as are the 3Rs (reduce, recycle, reuse), which refer to using fewer resources and materials to improve efficiency in product manufacturing (Kirchherr et al., 2017). These "R" practices, therefore, play a central role in developing the theoretical framework, as they represent the fundamental principles of CE. They encapsulate the idea of minimizing waste, extending the useful life of products and resources, and reducing environmental impact (Ellen MacArthur Foundation, 2013).

Another category that was selected is "Design and Innovation Practices," which addresses the development of green and circular products/services, material selection, innovation, and eco-innovation in companies (Prieto-Sandoval et al., 2019); ecodesign (mentioned in seven articles) is highlighted, encompassing environmentally conscious products and business models. This practice creates solutions that align with CE principles. Circularity-centered design aims to create products and services that can be reused, recycled, and have a lower environmental impact (Alvarez-Risco et al., 2021).

"Absorption Practices" were also included in the framework as they refer to companies' knowledge of customer needs, the market, supplier feedback, and competitor actions. In CE, the absorption of knowledge regarding best circular practices, new sustainable technologies, and innovative business strategies is fundamental to a successful transition (Khan et al., 2021).

"Collaborative Practices" was not included in the theoretical framework, as they pertain to external partnerships and industrial symbiosis (meso-level) (Calicchio Berardi & Peregrino de Brito, 2021). "Management Practices" was also not included because the findings regarding these practices addressed issues related to waste management (cited in 4 articles) and resource management (water, nutrients, and energy recovery), which are macro-level aspects of CE (Ddiba et al., 2020).

After describing the constructs within the framework's scope, Tables 5 and 6 present the associations between DC and CE practices and between DC and transition barriers, respectively.

Table 5 - **Association of CD with EC practices that can be implemented through the development of CD**

CD	Practices	How can capacity help in implementing these practices?	Authors
Design and Innovation	Design and innovation practices for the CE and the "Rs" practices for the CE	Design capabilities can aid in the development of new products and business models that reduce environmental impact. Furthermore, innovation capabilities are important, as they address "circular eco-innovation," which is based on indicators of eco-efficiency, productivity, reduced resource use, and minimization of pollution from	(Iacovidou, Hahladakis, et al., 2021b; Sehnem et al., 2022b; Vihma & Moora, 2020)

CD	Practices	How can capacity help in implementing these practices?	Authors
		production processes.	
Absorption	Absorption practices for EC	Learning capacity contributes to four dimensions: the acquisition, assimilation, transformation, and application of knowledge.	((Zapata-Cantu et al., 2020)
	The "Rs" practices for EC		
Organizational	Practices "Rs" for EC	Organizational capabilities enable the company to collectively carry out coordinated sets of activities using organizational resources to achieve a specific purpose.	(Ddiba et al., 2020b; de Mattos & de Albuquerque, 2018; Eikelenboom & de Jong, 2021; Khan et al., 2021; Teece, 2007)

Source: Authors (2023)

Table 6 - **Association of CD with transition barriers that can be overcome through the development of CD**

CD	Barriers	How does capacity help reduce barriers and facilitate the implementation of practices?	Authors
Design and Innovation	Business Model Issues (1, 4, 12)	Design capabilities are necessary to overcome barriers related to the development of circular products, that is, in the design and selection of materials that support more sustainable production. Furthermore, this relates to barriers stemming from a lack of technology regarding circular innovations. The goal is to adopt cleaner production practices and extend product life cycles.	(17)
	Product Design Issues (3, 4, 11)		
	Lack of Technology (1, 2, 3, 4, 14, 15)		
	Lack of Standardization (11, 15, 17, 18)		
	Lack of R&D (1, 15)		
Absorption	Lack of Knowledge (1, 2, 5, 7, 9, 13, 15, 17)	Absorptive capacity is linked to the organizational skills required for knowledge management. As such, it is related to knowledge-related barriers.	(19, 20, 21)
	Lack of R&D (1, 15)		
	Lack of Consumer Awareness (11, 12, 16, 17)		
Organizational	Lack of Qualified Human Resources(3, 9, 10, 12, 14, 15)	Organizational capabilities are crucial for developing business strategies that incorporate circular practices, as they help address cultural, regulatory, technical, market, and financial barriers within the company.	(6, 22)
	Management Issues (1, 2, 5, 11, 13, 17)		
	Business Model Issues (1, 8, 13)		

Source: Authors (2023)

Note: *1:(Ada et al., 2021); 2: (Chhimwal et al., 2021); 3: (De Jesus & Mendonça, 2018); 4: (Dieckmann et al., 2020); 5: (Droege et al., 2021); 6: (Eikelenboom & de Jong, 2021); 7: (Ezeudu & Ezeudu, 2019); 8: (Fux, 2018); 9: (Garcés-Ayerbe et al., 2019b); 10: (García-Quevedo et al., 2020); 11: (Govindan & Hasanagic, 2018); 12: (Kant Hvass & Pedersen, 2019); 13: (Kayikci et al., 2021); 14: (Kazancoglu et al., 2021) 15: (Kumar et al., 2019); 16: (Salvador et al., 2020); 17: (Sehnem et al., 2022b); 18: (Stumpf et al., 2021); 19: (Alonso-Muñoz et al., 2021); 20: (Kristoffersen et al., 2021); 21:

(Marrucci et al., 2021); 22: (Khan et al., 2021)

Thus, based on this information and the analyses described in Tables 5 and 6, these constructs were linked together, thereby generating the theoretical framework (Figure 4) that integrates the DC necessary to address the barriers companies face during the transition to circular practices. The central idea of the framework is to show that DC are important and help companies in this transition, assisting in reducing the barriers that hinder the adoption of circular practices. As shown in Figure 4, all the mentioned capabilities address at least three barriers to the circular economy. For example, design capability helps overcome product design barriers, as it encompasses developing products and new business models that reduce environmental impact, as highlighted by the authors Vihma & Moora (2020). In doing so, innovation and design practices improve manufacturing processes, design for efficient manufacturing, and other areas that are more easily implemented by organizations, helping create more durable products that support the circular approach (De los Rios & Charnley, 2017).

Another relevant capability is the absorptive, which, in this case, helps address consumers' lack of awareness and knowledge, as well as the need for R&D to implement the "Rs" and absorption practices. This capability involves the acquisition and assimilation of knowledge. Armed with this knowledge, the company can overcome social and cultural barriers.

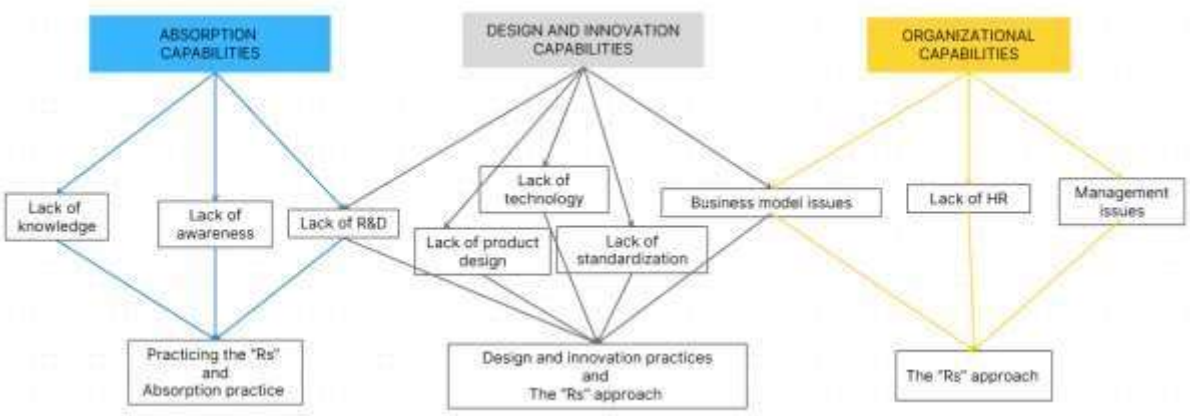

Figure 4 - **Theoretical framework**
Source: Authors (2023)

Finally, organizational capacity, which is intrinsically linked to a company's internal aspects from a strategic and organizational perspective (Sehnem et al., 2022), plays a crucial role in addressing the complexities inherent in business management. This capability emerges as an essential tool for overcoming challenges ranging from a lack of organizational structure to management issues and problematic business models. These issues are particularly important in the search for business strategies that are intrinsically aligned with circular practices (Eikelenboom & de Jong, 2021). Organizational capability is an undeniable facilitator of the 4Rs principle (Reduce, Reuse, Recycle, and Recover), as cultivating and expanding these capabilities can significantly impact corporate sustainability, as noted by Shrivastava & Hart (1995). With these capabilities, organizations can sense, harness, and reconfigure their resources to overcome barriers and adopt CE practices.

Concluding Remarks

The central objective of the article was to develop a theoretical framework using the SLR method to identify barriers and DCs and to examine their relationships with the implementation of CE practices. After analyzing 106 articles, it was found that publications have been growing over the years, employing predominantly qualitative approaches, with Europe standing out as the continent where the research is applied. Nine categories of barriers, three categories of DCs, and three categories of CE practices were identified as fundamental to the development of the theoretical framework.

The article makes several contributions. First, the research overview shows that it is an emerging theme that still needs further exploration. Second, identifying barriers to CE implementation and the DCs that can be used to overcome them represents a contribution. Once this information is recognized, future researchers can use this knowledge base to explore barriers that are less cited in the literature, to understand how public policies or business actions can be proposed to reduce such barriers, and to seek explanations for why companies face these barriers. This information is also useful for companies seeking to adopt a circular business model, as it provides prior knowledge of the main barriers and challenges faced by organizations. Third, by understanding the DCs that can help overcome these barriers, companies can direct their efforts toward developing the competencies necessary for a successful transition to the circular economy. Fourth, the development of the theoretical framework represents a valuable contribution, as no works were found in the literature that sought to carry out this type of integration. Most investigations tended to focus on isolated aspects of barriers and DCs, often neglecting the complex interconnection between these two crucial elements in the context of the transition to the CE. By uniting barriers and DCs in a single conceptual framework, this study provides a business diagnostic tool to explore how these factors interact and mutually influence the circular transition process. In addition, it fills a gap in the understanding of these interactions, providing a conceptual foundation for future investigations and guiding business strategies. Fifth, this paper can be particularly valuable for companies seeking to adopt a circular business model. The information and insights presented in this article can serve as a diagnostic tool and strategic guide, helping organizations understand that DCs are key to overcoming barriers. This allows companies to prioritize investments in internal development and capacity building that best align with their specific needs.

The paper also identifies some limitations that could become opportunities for future studies. One of the initial limitations is linked to the use of the SLR methodology. Although SLR is a rigorous and structured approach to examining existing literature, its effectiveness depends on the quality and breadth of the keywords used in the search. In this context, the selected keywords may not have fully covered all the terminological variations associated with the barriers and dynamic capabilities of the circular economy. Thus, future research can expand the scope of the strings to increase the number of articles to be analyzed. Another limitation is the lack of practical application of the framework. Although it was built upon a comprehensive literature review and has shown promise in identifying barriers, DCs, and CE practices, it has not yet been tested or implemented in practice through case studies, for example. Finally, given these limitations, future studies could focus on evaluating the impact of implementing the framework within organizations. This could include measuring tangible improvements in the implementation of CE practices, reducing barriers, and enhancing sustainable operations.

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