UNIVERSITY OF SÃO PAULO
SÃO CARLOS SCHOOL OF ENGINEERING

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Proposal of a roadmap for culture change towards a circular economy: application in a product-as-a-service business model

São Carlos
2023

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Proposal of a roadmap for culture change towards a circular economy: application in a product-as-a-service business model

Thesis presented to the São Carlos School of Engineering of the University of São Paulo in partial fulfillment of the requirements for the degree of Doctor of Science in Production Engineering.

Subject area: Processes and Operations Management

Advisor: Prof. Dr. Mateus Cecilio Gerolamo

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CORRECTED VERSION

São Carlos

2023

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Bertassini, Ana Carolina

B536p Proposal of a roadmap for culture change towards a circular economy : application in a product-as-a-service business model / Ana Carolina Bertassini; Dissertation directed by Mateus Cecilio Gerolamo. -- São Carlos, 2023.

Doctoral (Dissertation) - Graduate Program in Production Engineering and Research Area in Process and Operation Management -- São Carlos School of Engineering of the University of São Paulo, 2023.

1. Circular economy. 2. Organizacional culture. 3. Innovation management . 4. Transition. 5. Roadmap. I. Title.

Elena Luzia Palloni Gonçalves – CRB 8/4464

FOLHA DE JULGAMENTO

Candidata: Tecnóloga **ANA CAROLINA BERTASSINI.**

Título da tese: "Proposta de um *roadmap* para mudança cultural rumo à economia circular: aplicação em um modelo de negócio de produto-como-um-serviço".

Data da defesa: 22/09/2023

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For my parents, Gilda and José, without you this would not be possible.

ACKNOWLEDGMENTS

To my parents, Gilda and José, for encouraging my formal education, believing in its power, and believing in me; for giving me the opportunities that they never had. Thank you for being examples of love, dedication, persistence and resilience. Thank you for teaching me how to be human, believe in the good, and in my capacity to achieve all my dreams. Thank you for being my safest place in the world, for supporting me in every decision and believing in this dream.

To my sister, Elaine, for always being example of work and determination, and for always being by my side no matter the distance. To my sister, Paula, for teaching me how to deal with strong personalities.

To my 'old ladies', Ana Laura, Júlia and Carol. Thank you for all the moments together, for all the coffees, and for being part of my life for everything that matters.

To the brothers that I never had, Lucas Calache, Lucas Zanon, and Rafa. Thank you for always being by my side, for all the laughs, parties, conversations, shared moments. Especially, thanks to Calache for being with me and giving me support since my very first day at USP.

To all the friends that shared with me the graduation journey and a lot of good moments outside of the university. All of you will be always with me. Thank you for sharing with me the challenges of the graduate course, for making my days better with laughs, conversations, food, and coffees.

To the friends who, even without being part of my academic world, were always by my side giving me strength and love. Thank you, Camila, Tayla, and Robert.

To the employees of the São Carlos School of Engineering, who collaborate daily to the research in our country. In particular, thanks to Jessyca, whom I could reach out to countless times.

To Professor Frank Piller, who welcomed me with open arms at the RWTH Aachen, made me part of the TIM team, and spared no effort to make me a better researcher.

To Professor Aldo Ometto, who welcomed me at USP in 2016 and has been by my side guiding me as researcher until now. It was an honour to be mentored and learn so much from you all those years.

To Professor Mateus Gerolamo, who embarked with me on the PhD journey. Thank you for all the opportunities, knowledge shared, and friendship. I have no words to thank you for all the support and opportunities you presented me. More than a supervisor, you are a friend for me.

To the companies and professionals that allowed the data collection of this research.

This study was financed by the São Paulo Research Foundation (FAPESP), grant number 2018/24830-6, and by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – grant Finance Code 001.

“Courage doesn’t always roar. Sometimes courage is the quiet voice at the end of the day saying ‘I will try again tomorrow’”.

Mary Anne Radmacher

ABSTRACT

BERTASSINI, A.B. **Proposal of a roadmap for culture change towards a circular economy:** application in a product-as-a-service business model. 2023. Thesis (Doctor in Science) - São Carlos School of Engineering, University of São Paulo, São Carlos, 2023.

Circular Economy (CE) is being considered as a plausible and desirable solution to build economic prosperity while respecting ecological and social boundaries. However, its implementation is slow-paced which is partially explained by the systemic nature of the innovation required. Disruptive innovations in business model (BM) foster the CE transition, but its process remains under-explored to date, mainly regarding organizational culture (OC) factors, hindering its implementation. Despite the existence of a voluminous literature on the subject, practitioners are either uncertain or struggling about how to implement circular business model (CBM). Using a multistep methodology, based on literature review and expert consultation we proposed a roadmap to guide companies in the transition journey towards the implementation of a CE-oriented culture. The roadmap is a stepping-stone to overcoming the challenges that companies face in making CE innovation long-lasting. This study identified that the most relevant aspects to be given attention for CBM innovation at the cultural level is the leadership having a circular mindset; the establishment of processes to make the innovations happen in all levels of the company; establish partnerships and collaboration with key players and educating employees (at all levels) towards CE and sustainability concepts and operations. To move towards disruptive CBM it is essential top and middle management commitment, early customer engagement in the solution proposition and business ecosystem management. This study corroborates and expands recent research on the soft side of CE transition and provides practitioners with a guideline to be followed to successfully innovate their BM towards CE.

Keywords: circular economy, organizational culture, innovation management, transition, roadmap.

RESUMO

BERTASSINI, A.B. **Proposta de um *roadmap* para mudança cultural rumo à economia circular:** aplicação em um modelo de negócio de produto-como-um-serviço. 2023. Tese (Doutorado) – Escola de Engenharia de São Carlos, Universidade de São Paulo, São Carlos, 2023.

A Economia Circular está sendo considerada uma solução plausível e desejável para construir prosperidade econômica, respeitando os limites ecológicos e sociais. No entanto, sua implementação é lenta, o que é parcialmente explicado pela natureza sistêmica da inovação necessária. Inovações disruptivas no modelo de negócios fomentam a transição para a economia circular, mas seu processo permanece pouco explorado até o momento principalmente no que se refere a fatores de cultura organizacional, dificultando sua implementação. Apesar da existência de uma volumosa literatura sobre o assunto, os profissionais estão incertos ou lutando sobre como implementar modelos de negócio circular. Usando uma metodologia iterativa, com base em revisão da literatura e consulta a especialistas, propusemos um *roadmap* para orientar as empresas na jornada de transição para a implementação de uma cultura orientada para a economia circular. O *roadmap* é um facilitador para superar os desafios que as empresas enfrentam para tornar a inovações circulares duradouras. Este estudo identificou que os aspectos mais relevantes a serem considerados para a inovação de modelo de negócio circular no nível cultural são a liderança com uma mentalidade circular; o estabelecimento de processos para que as inovações aconteçam em todos os níveis da empresa; estabelecimento de parcerias e colaboração com os principais atores e educação dos funcionários (em todos os níveis) sobre os conceitos e operações de economia circular e sustentabilidade. Para avançar em direção à modelos de negócio circular disruptivos, é essencial o comprometimento da alta e média gerência, o engajamento dos clientes logo no inicio do desenvolvimento da solução circular e a gestão do ecossistema de negócios. Este estudo corrobora e expande pesquisas recentes sobre o lado *soft* da transição rumo à economia circular e fornece aos profissionais uma diretriz a ser priorizada e seguida para inovar com sucesso seu modelo de negócio em direção à economia circular.

Palavras-chave: economia circular, cultura organizacional, gestão da inovação, transição, roadmap.

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LIST OF ABBREVIATIONS

BE	–	Business Ecosystem
BM	–	Business Model
BMI	–	Business Model Innovation
CBM	–	Circular Business Model
CE	–	Circular Economy
CM	–	Change Management
ESG	–	Environmental, Social and Governance
MC	–	Mass Customization
OC	–	Organizational Culture
PaaS	–	Product-as-a-Service
RBV	–	Resource-based view
RQ	–	Research Question
SDGs	–	Sustainable Development Goals
SLR	–	Systematic Literature Review

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1. INTRODUCTION

Since 1896, there have been indications and research concerns about the climate change. Literature records indicate that the study by the Swedish chemist Svante Arrhenius in 1896 was the first to explore the idea that increased concentrations of carbon dioxide in the atmosphere could lead to a warming effect. Since then, each year has seen higher global temperatures and other climate effects related to extreme weather conditions beyond just hot temperatures.

Climate change deeply affects the environment, economies, and societies globally. Human activities contribute to rising greenhouse gas emissions and resources depletion, causing disruptions in the ecosystem, threatening biodiversity, food security, water resources, and human health (IPCC Report, 2021). Addresing climate change requires a paradigm shif toward an economic model that allows us to 'live in peace' with the environment.

Dominant product-based business models (BM) and their underlying value logic face increased competitive pressure, with established product offerings converging towards commodity status (Brenk et al., 2019). Businesses are under growing pressure from consumers and governments to act more responsible towards the environment (Hankammer et al., 2019). Consequently, organizations need to change their operating logic. Science, technology, and innovation play a key role in addressing societal challenges for sustainable development. Circular Economy (CE) has emerged as a significant innovation to build economic prosperity while respecting ecological and social boundaries. CE promotes a vision to keep resources in a circle throughout product's life, providing strategies to decrease resource dependency and enable product longevity (Parida et al., 2019; Hankammer et al., 2019).

However, despite the potential benefits of CE, the global eonomy currently only cycles 8.6% of its resources (Circle Economy, 2022), highlighting a significant circularity gap of over 90%. This underscores the urgency of rectifying our current trajectory. As societies transition, technological obstacles impede advancements in renewable energy and sustainable mobility, contributing to a less circular economy. The imbalance in the circularity equation is exacerbated by a lack of incentives for businesses to adopt circular practices and a scarcity of policies promoting circularity (EMF, 2019). An organizational culture that embraces circular principles becomes pivotal in navigating these challenges.

The CE is not just an environmental ethos; it is a necessity driven by the urgent need for sustainable materials. Traditional linear models are proving unsustainable, necessitating a shift towards circularity for resilient and diversified supply chains (World Economic Forum, 2022).

Circular practices not only contribute to mitigating climate change but also enhance long-term economic viability. While technological and market considerations are crucial, organizational culture plays a profound role in embracing circular principles. A culture that values sustainability, innovation, and responsibility is foundational for successful circular business models (Accenture, 2021). Shifting attitudes to prioritize longevity over disposability is essential, transforming waste into a valuable resource.

The transition journey towards CE is affected by a range of global and local change agents, forcing business to reconsider their models and culture to leverage disruptive innovations towards Circular Business Models (CBM). CBM innovation incorporates CE principles as guidelines for BM design (Pieroni et al., 2019), aiming to boost system resilience, resource effectiveness, and closure of energy and resources flows (Antikainen et al., 2017; EMF, 2012) through narrowing, slowing or closing resources and energy loops (Bocken et al., 2018; Urbinati et al., 2017).

In the era of digitalization and the technologies from the fourth industrial revolution, there is a need to create BM that effectively deliver values to consumer (combined with the sustainable and circular requirements). This is being achieved by the product-as-a-service (PaaS) BM as a circular strategy to preserve the natural capital.

PaaS is one type of CBM considered the most powerful business strategy to leverage CE due to its potential for dematerialization and the development of collaborative partnerships in the business ecosystem. In a PaaS business ecosystem (BE), companies focusing on services can increase revenues due to better assest utilization. In this case, recurrent revenue can reduce the market volatility and provide better control over strategies such as remanufacture and refurbshiment, resulting in operational costs reduction and mitigating the effects of raw material prices fluctuations. In PaaS BE, there is also an opportunity to build strong and long-lasting relationships with consumers. This CBM fosters the production of more durable and easier to repair/upgrade products, modular design, and investments in preventive maintenance (Bertassini et al., 2023), contributing to circularity of resource flows and strengthening the competitive advantage of organizations (Hankammer et al., 2019).

Integrating PaaS into business processes can catalyze circular practices. PaaS facilitates tracking material flows, optimizing resource use, and fostering collaboration among stakeholders. Mandating PaaS in specific sectors can institutionalize circular practices, making sustainability a standard part of business operations (European Commission, 2021). Prioritizing sectors based on their environmental impact is crucial for effective CE implementation. Sectors such as manufacturing, construction, and electronics are significant contributors to resource

consumption and waste generation (McKinsey & Company, 2020). Initiatives should focus on these sectors to maximize material efficiency and waste reduction, ensuring a more sustainable future.

In a transition period between the 'old world' (linear economy) and the 'new world' (circular economy), there is a natural concern and anxiety as we move out of our 'confort zone'. Implementing a disruptive CBM such as PaaS requires a mindset change, shifting from a company focused on developing and selling products to one focused on providing functionality through services (Sousa-Zomer et al., 2018). This kind of CBM often requires institutional change to allow products to be accessed, shared, and sold outright; products, components and materials to be categorized, sorted, and treated accordingly when returned from use; and various other ways to handle unfamiliar reverse flows, remanufacturing and repairing, and non-ownership-based usage models that are part of the CE concept (Rozenfeld et al., 2018; Spring & Araujo, 2017). PaaS requires significant changes in mindset (Weeks & Benade, 2010) that cover strategy, organization, enterprise management, contracting, culture, and operations management, reframing the entire firm, its network, and the ecosystem in which it operates (Martinez et al., 2019; Nguyen et al., 2014). Changes in mindset are connected to changes in organizational culture, which, in turn, are related to changes in company's structure to fit the new CBM at the BE level.

The transition towards CE is the result of the involvement of all actors in society and their ability to link and create adequate patterns of collaboration (Gruba et al., 2022) to deal with the disruptive BM innovations in a multistakeholder ecosystem (Ihrig & MacMillan, 2017), making the process of identifying successful innovations and driving long-term structured changes complex. Changes in BM towards CE may conflict with existing shared mental models, along with many factors that restrain the strategic decisions required to innovate in BM, such as operational routines, strategic complexity and organizational inertia (Brenk et al., 2019). Innovating in BM requires organizational learning, flexibility, reconfiguration of organizational structures, and culture. However, in most cases, leaders and managers remain unaware of the potential of BMI (business model innovation) because they are biased towards the existing BM logic (Brenk et al., 2019).

Achieving a sustainable society through CE requires transformational changes. A transformational change is associated with a shift that is comprehensive (fundamental, truly new and revolutionary), large-scale (including the whole system) and/or quick (a sudden jump, achieved in a relatively short amount of time) (Termeer et al., 2017). However, it is impossible for in-depth change occur overnight on a large scale. Companies need to disrupt their routines

and experiment with, and learn about, different modes of behaviours to incorporate change (Cramer, 2020). Thus, continuous transformational change is an option that allows the occurrence of a variety of changes that differ in depth, scale and speed, depending on the context (Cramer, 2020; Termeer et al., 2017). While there is significant literature and theoretical models available in the general field transition and change from an old state to a new one, a few authors focused on the study of approaches (frameworks or roadmaps) to guide and support transitions to more circular systems.

Some authors highlight the need for an approach that helps traditional companies in moving towards CE. Palafox-Alcantar et al., (2020) say that a system operating in accordance with CE principles only will be possible when the current operational paradigm is understood and mapped, its current performance (regarding CE) established and a rigorous diagnosis of the problems of transformation to a CE carried out. Moggi & Dameri, (2021) affirm that a circular BE should incorporate multistakeholder engagement tools for sharing knowledge and best practice. Establishing CE requires the implementation of cultural changes characterized by increasing the importance given to environmental and community issues by practicing comprehensive stakeholder engagement (Salvioni & Almici, 2020).

Despite all the efforts on developing the CE literature, organizational behaviour aspects of CE transitions are little explored, and existing studies do not have many attempts on advancing the understanding of institutional processes that constrains path-breaking, long-lasting and wide-scale changes. In addition, the value elements of a CBM are very different when compared with conventional business models (Lewandowski, 2016; Pieroni et al., 2019), as in CBM, companies also aim for societal and non-monetary value. Moreover, CBM requires co-creation of users, customers, suppliers and other ecosystem partners, who have to be integrated into the transition and innovation management process. In this sense, there is a need to understand how the innovation and changes in cultural aspects could be managed to allow the organization to learn and evolve to a more circular culture. Thus, **the aim of this thesis is proposing a roadmap (set of guidelines) to guide companies in the transition journey towards the implementation of PaaS at the organizational culture level.**

Related to the main goal of this thesis, this study proposed and answered the following research questions (RQs): RQ1 - Is there a culture, i.e., a set of shared values, that reflects circular economy goals and principles?; RQ2 - what are the building blocks of a CE-oriented culture?; RQ3 - how can the transition towards a circular business model be supported by a CE-oriented culture?. Table 1 presents the RQs and their relation to the main deliverables of the study. The deliverable (I) was accomplished through a systematic literature review (SLR)

aiming to answer the RQ1 and RQ2. The deliverable (II) used two distinct fuzzy multicriteria decision making method to validate the CE-oriented culture building blocks and to calculate the level of CE-oriented culture of companies aiming to answer RQ2 and RQ3. The deliverable (III) through a SLR and case study proposed a list of good practices to implement PaaS aiming to answer part of RQ3. The deliverable (IV) was developed through an SLR and qualitative research with experts aiming to answer RQ3.

Table 1: Relationship between RQ's and Deliverables

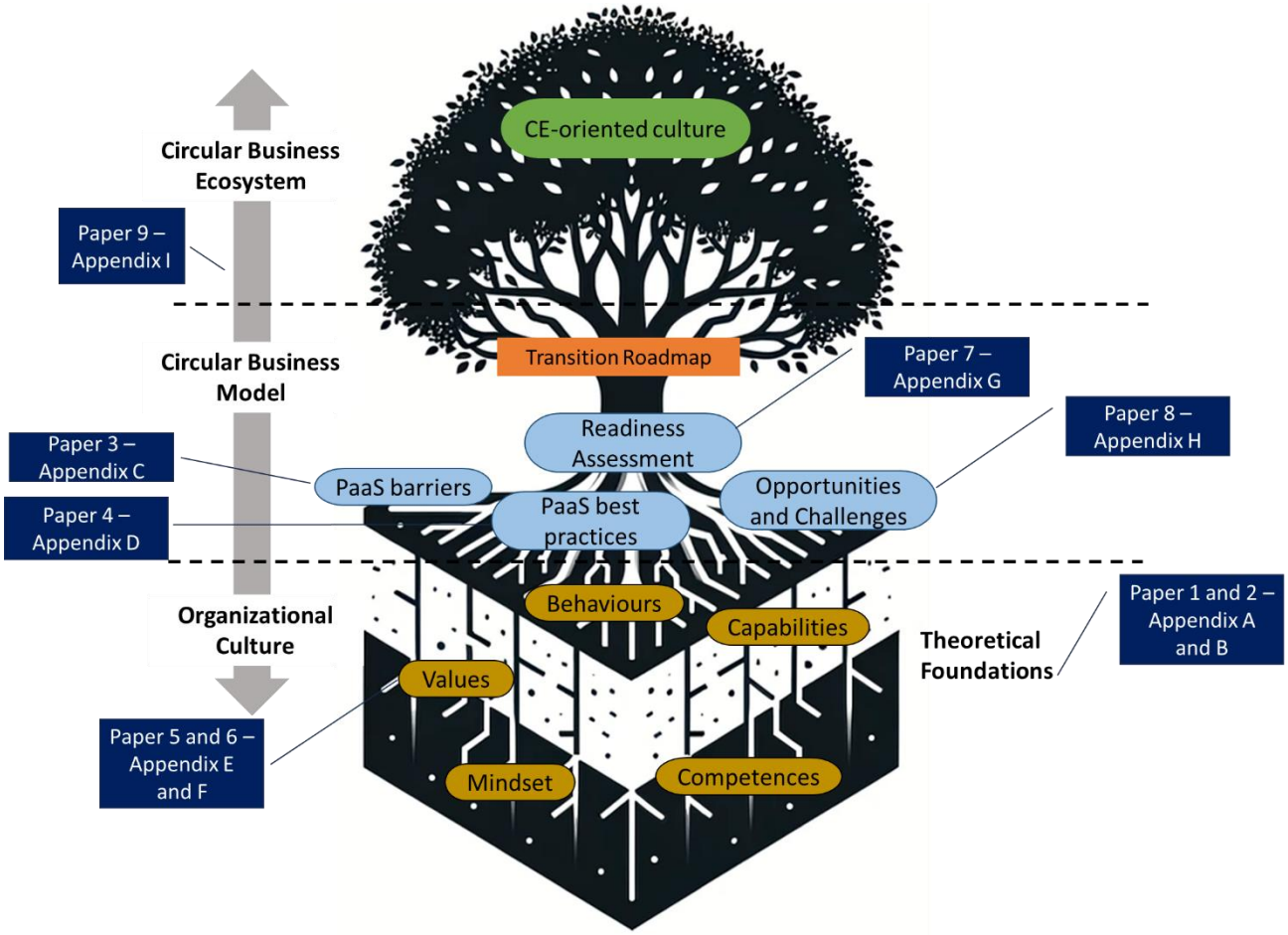
	Research Questions		
Deliverables	RQ1: Is there a culture, i.e., a set of shared values, which reflects circular economy goals and principles?	RQ2: what are the building blocks of a CE-oriented culture?	RQ3: how can the transition towards a circular business model be supported by a CE-oriented culture?
I. A theoretical framework with the requirements and proposition to an ideal CE-oriented culture	✓	✓	
II. An assessment approach to evaluate the level of CE-oriented culture in companies		✓	✓
III. A list of good practices to implement PaaS in companies			✓
IV. A roadmap to guide the transition towards a CE-oriented culture			✓

1.1.Research Design and Overview

This research employs a prescriptive hypothetico-deductive approach, which involves developing a conceptual and theoretical framework before empirically testing it through observation. Figure 1 illustrates the foundational elements and structure of this research. We have used a tree metaphor to represent the idea that implementing CE at the cultural level should be a natural and evolutionary processes, akin to the growth of a tree. At the deepest roots of the tree lie the theoretical foundations of this research and positioning of our study within the domain of organizational culture. Nearer to the surface are the technical elements considered in the transition to the CE within the circular business model. The tree trunk symbolizes the

transition processes. The leaves of the tree represent the CE-oriented culture, while the branches signify the various stakeholder that comprise the circular business ecosystem and share this culture. The arrow connecting organizational culture, circular business model, and business ecosystem underscores the necessity for alignment among these levels. This figure also depicts the papers that emerged from the parts presented as the roots in the development of the transition roadmap. The subsequent sub-sections will provide a detailed explanation of the steps followed taken to conduct this research.

Figure 1: Research Structure



1.2. Problem & Motivation: literature review of previous knowledge and existing theories

The goal was to provide a theoretical foundation for the study and the development of the roadmap. This was achieved through an exploratory literature review, identifying evidence to support the research assumptions. The introduction offers a brief overview of the research topic, clarifying the research problems and questions, and outlining the research objectives and deliverables. The theoretical background section delves into an in-depth study of the theories and concepts relevants to this research. This involved: *(I) reviewing literature on CE* to

understand the field and its fundamental concepts, particularly regarding implementation in companies; *(II) exploring literature on Change and Transition Management* to grasp the main elements and concepts of each field and their interrelation; *(III) investigating literature on Organizational Culture* to comprehend its basic concepts and its influence on organizational transformation.

1.3.Objectives of the solution: development of the theoretical framework

In this phase, we established the theoretical framework and identified the literature challenges using a SLR, bibliometric, and content analysis. We also proposed a list of best practices for companies to implement PaaS. The process involved: *(I) synthesizing previous literature that combine CE with change management (CM) and/or organizational culture*, identifying connections between CE and soft aspects of organizational behaviour. The outcomes of this step were published in the journal Business Strategy and the Environment, and the full paper is included in appendix A. The theoretical framework in appendix A formed the conceptual basis for constructing the roadmap. Additionally, the paper in appendix B, presented in the PLATE conference 2021, supplemented the theoretical framework with case study findings. A literature review and market research were conducted to *(II) identify the best practices for implementing PaaS in companies. T*he paper in appendix C, presented at the EurOMA 2022 conference, detailed these practices and their application in a case study. Complementing this, the paper in appendix D[1], presented in the SIMPEP 2022 conference, identified the main barriers to adopting PaaS.

1.4.Design & Development: assessment approach and cultural roadmap

The objective was to develop an assessment approach for evaluating the level of CE-oriented culture in companies and to propose the CE-oriented culture transition roadmap. The activities included: *(I) developing and testing the assessment approach* starting with two complementary papers on identifying values reflective of a CE-oriented culture. These papers, published in GCV 2020 conference (appendix E) and the journal RAE (appedinx F), provided insights for the assessment approach. The assessment approach involved systematizing the building blocks and elements of circular organizational culture; selecting appropriate fuzzy techniques for unbiased analysis, developing and characterizing the maturity levels of circular organizational culture for CBM implementation, and validating the approach with field experts. These steps are detailed in the paper in appendix G, published in the Journal Sustainable Production and Consumption. The original approach by Bertassini et al., (2022) was reviewed

[1] This paper was published in Portuguese.

and validated by two CE experts. The updated version of the approach is available on the CHANGE research group[2] website. (*II) the development of the cultural roadmap* beagn with a conceptual version based solely in literature findings, which was then refined using insights from field experts. Two additional papers were presented/published in conferences: one in appendix H at the MCPC 2023 Conference, discussing the integration of CE with Mass Customization (MC), and another in appendix I at the IPDMC 2023 Conference, exploring the interplay between BM, OC and BE management for CE implementation.

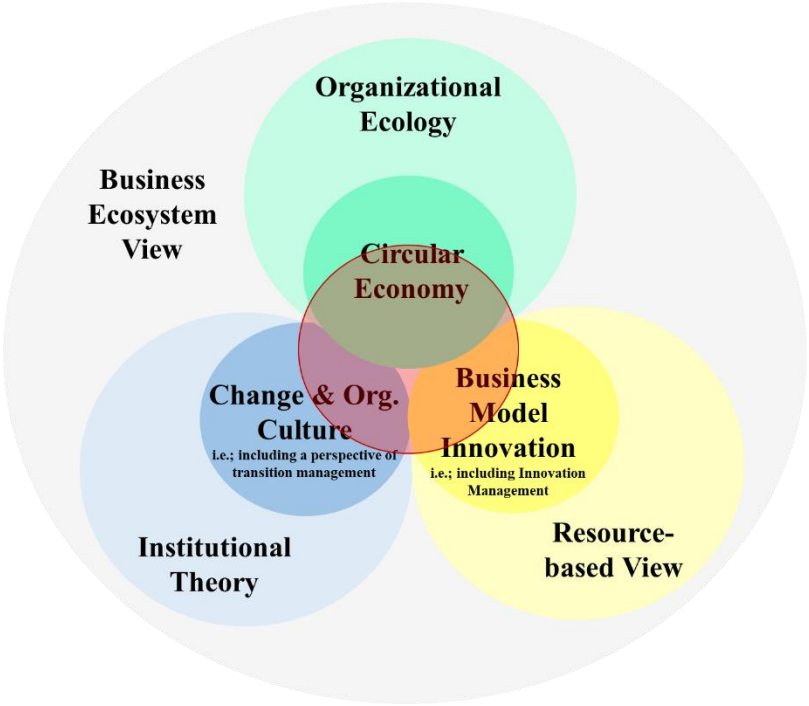
This thesis comprises six sections. Section 1 introduces the context, research problems, objectives and design. Section 2 reviews the literature review forming the basis of this research. Section 3 describes the methodological structure and the methods used to reach the research objectives. Section 4 presents the results and discussions. Section 5 concludes with research implications, limitations, and future research opportunities.

[2] The updated version of the approach can be accessed in the following platform: http://change.prod.eesc.usp.br/home-2/research-areas/circular-economy/ce-oriented-culture-readiness/.

2. THEORETHICAL BACKGROUND

The conceptualization of the CE-oriented cultural transition roadmap was based on identifying existing approaches and combining concepts from circular economy, innovation management, change management, transition management, and organizational culture. The theorethical foundations of this research are grounded in three organizational theories: institutional theory, resource-based view, and organizational ecology. These are integrated, as depicted in Figure 2, and studied from a BE perspective. The BE view is employed in this research because it equally considers all stakeholders and intregrates various business models to achieve a common goal (Konietzko et al., 2019). Organizational theories are crucial for understanding and explaining the behaviors, designs, and structures of organizations adopting circular systems (Flynn et al., 1990; Meherishi et al., 2019).

Figure 2: Theorethical foundations and intersections



Institutional theory examines how an organization's external environment (regulatory structures, governmental laws and policies, society) influences its decision-making and practices (Dimaggio & Powell, 1983; Tyson & Adams, 2020). It categorizes organizations into three regulative, normative, and cultural-cognitive types (Linnenluecke & Griffiths, 2010). This research focuses on the cultural-cognitive category, which encompasses cultural belief systems and shapes stakeholder's behaviours within organizations (Tyson & Adams, 2020). Change

management and organizational culture are considered under Institutional Theory in this research. While institutional theory does not directly discuss CM, it provides insights into how institutional factors shape the adoption, acceptance, and implementation of change in organizations. Similarly, while not focusing directly on OC, institutional theory recognizes the impact of broader institutional context on organizational practices and behaviours. Organizations may conform to institutional pressures by aligning their culture with prevailing industry or societal norms, or they may challenge or resist those norms through their unique culture.

The resource-based view (RBV) sees firms as a bundle of resources (Barney et al., 2001) including financial capital, assets, human skills/knowledge, organizational processes, and technologies (Connelly et al., 2011). The RBV posits that competitive advantage is sustained when an organization's resources are inimitable and non-substitutable (Barney, 1991). Forming the basis for sustainable competitive advantage through enhanced innovation performance (Hamel & Prahalad, 1996). In CE, innovations in BM are used to maintain competitive advantage (Barney et al., 2001; Zott et al., 2011). The BMI concept is built on RBV and dynamic capabilities, providing a structured approach to model organizational activities and managerial conditions (Teece, 2010; Zott et al., 2011). This research also incorporates innovation management concepts, suggesting that a firm's ability to manage and leverage its resources and capabilities for innovation contributes to its competitive advantage. The role of circular BMI in the implementation of PaaS is addressed.

Organizational ecology focuses on organizational characteristics and processes that enhance a firm long-term survival. It examines survival-enhancing features and selection processes arising from environmental change and considers new organizational forms (Connelly et al., 201; Meherishi et al., 2019). Although CE and organizational ecology differ in approach, this research views CE as part of organizational ecology theory. For instance, and organization adopting CE principles may be better positioned to adapt to changing resource availability and environmental constraints, aligning with the principles of organizational ecology theory.

This section aims to provide a comprehensive overview of the main subjects related to this research, focused on the organizational behavior transformation towards CE. It explains how different field are connected (Section 2.1.) and reviews availabe CE transition approaches (Section 2.2).

2.1.Conceptual foundations for developing a CE cultural transition roadmap

Recent decades have seen the sustainable and circular paradigm evolve and strengthen, with the innovation process incorporating elements this paradigm. This has brought sustainability and innovation management closer together (Hronszky, 2009). Implementing CE and sustainability at the micro level highlights the role of innovation management as a key tool for organizations to adhere to sustainable development (de Queiroz Machado et al., 2022). It involves improving skills for handling new technologies, markets, and environmental conditions or regulations (Seebode et al., 2012).

Achieving long-lasting changes and institutionalizing CE requires deep changes in sociotechnical systems, referring to the co-evolution of social and technical aspects (Savaget et al., 2019). The co-evolution perspective is characterized by equilibrium related to periods of slow change and periods of radical change, mostly used to conceptualize the sustainable development as a continuous process of adaptation (Kemp et al., 2007). Transition towards CE necessitates changes at different levels: firm-wide traits (purpose and structure, shared values and beliefs); functional level (processes and systems), and individual level (individual value, beliefs, motivations) (Zollo et al., 2013). These changes influence how organizations interact to develop resilient and collaborative business ecosystems promoting societal changes.

Change and innovation are prerequisites for establishing a CBM, such as PaaS. Transition management, change management, and innovationa management are considered complementary in this research: innovation management supports the development of radical innovations towards CE, focusing on the technological factors; CM aids companies in learning about CE implementation and serve as a toolbox for managing behavioral changes during the transition process.

Change Management develops organizational competences and capabilities to deliver business results whereas Transition Management provides frameworks and insights for governing fundamental transformations in socio-technical systems. Innovation Management formalizes the innovation process, facilitating the systematization of new methods, ideas, and products. Change is imperative for these concepts, as they constantly occur wheter desired or not. TM takes a broad view, bringing together multiple sociotechnical stakeholders to influence governance and accelerate change towards more sustainable and resilient systems (Loorbach, 2010; Loorbach & Wijsman, 2013). CM focuses on specific organizations and how change programs are conducted, considering aspects like organizational culture, leadership, strategy, organizational learning, and organizational alignment (PROSCI, 2018). Innovation

Management enables firms to transfer learned knowledge and offer better solutions (Maranville, 1992) to meet new social needs and implement innovative ideas and decisions (Cegarra-Navarro et al., 2016).

Transitions are processes of structural change in societal systems such as energy supply, mobility, and healthcare (Geels, 2002), resulting from external societal changes and endogenous innovations. They involve synergic and multiple changes at various levels (international, national, regional and corporate), requiring time and collective efforts (Saritas et al., 2019). Transition management is "the systematic study and design of an organization's strategy and supporting structures, followed by the formal planning, implementation, and monitoring of the changes required" (Ackerman, 1982, p. 49). It aims to stimulate and steer change towards sustainability by connecting short-term action with a long-term vision of transformation (Malekpour et al., 2020). Governance activities in transition processes includes strategic (long-term cultural changes in societal system – 30 years changes), tactical (mid-term changes -5/10 years- in dominant structures like rules, institutions, organizations and routines), operational (short-term changes in practice and projects within innovation projects and programs -0/5 years), and reflexive (monitoring, assessment and evaluation of ongoing policies and societal changes) (Kemp et al., 2007; Loorbach, 2010). The transition towards CE relies on co-evolution and interaction at these governance levels. Different stakeholders collaborate to improve interactions between different levels of a societal system, using system insights to create strategies for influencing subsystems (niches) towards a more circular and sustainable direction. Creating this systemic alignment is challenging and requires time and joint effort. The roadmap proposed in this study is applied at the tactical level, aiming to change the culture of organizations.

Organizational culture changes are not fully understood by TM theory, making CM theory a valuable complement for deeply understanding the softer side of transition. CM is the process of continually renewing an organization's direction, structure, and capabilities to meet the changing needs of external and internal customers (Moran & Brightman, 2001; Todnem, 2005). It is also defined as "the practice of applying a structured approach to transition an organization from a current state to a future state to achieve expected benefits" (ACPM, 2014). Changes are effective when organizations focus their efforts on defining the vision (expected results) of the change management program (Schaffer & Thomson, 1992). However, an effective long-term vision, especially for the CE, is established when organizations understand their role in the business ecosystem and align it with other stakeholders. Organizational alignment, like natural ecosystems, captures the concept of dynamism in the organization,

viewing it as a living being rather than a static entity (Gattorna, 2006). Living beings strive for equilibrium, but there are strengths that try to move the system in opposite directions (Schein, 2002). These forces are not aligned in terms of change direction, meaning any stakeholder may initiate a change process towards CE.

In the CE context, there are two types of companies: those born with a circular DNA and traditional companies transitioning towards circularity. Traditional companies are usually large, robust, bureaucratic, and hierarchical, which implies resistance and challenges in conducting disruptive changes towards CE. These companies have the resources and physical structure for the transition but often lack right organizational culture and mindset to support the journey (Geissdoerfer et al., 2017; Korhonen et al., 2018; Pieroni et al., 2019).

Organizational culture is the collective programming of the mind that distinguishes members of one organization from another (Hofstede, 2011). It is considered valid for those sharing the same context, including all stakeholders part of the system (Hofstede; Hofstede; Minkov, 2010). Organizational culture often plays a key role in hindering or fostering the implementation of innovation, as affirmed by Schein (1984, p. 3) "organizational culture is the key to organizational excellence". However, OC is frequently overlooked in CE context, despite being a primary factor in the success or failure of organizational changes (Linnenluecke & Griffiths, 2010). Failure often occurs when tools and strategies are well developed, but the organization's fundamental values and beliefs remain unchanged (Cameron & Quinn, 2011).

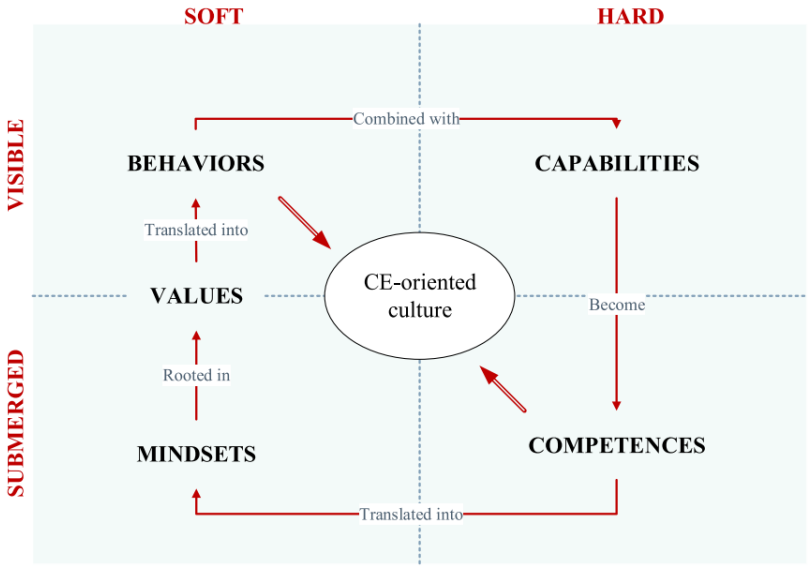
Technical challenges in transitioning to CE can be overcome only if people within and outside organizations are open to embracing and learning decision-making approaaches (Bertassini et al., 2021). Organizations should develop new capabilities to change their business vision and scope, creating additional value for their business ecosystem stakeholders. Beyond being part of an open innovation environment, companies embracing CE should engage in collaborative atmospheres, as PaaS depends on and cannot exist without collaboration from partners essential for closing the loops (Zucchella & Previtali, 2018).

Programs to improve sustainability towards CE implementation can range from minor modifications to existing routines to radical, transformational changes in company operations. There are two dimensions to changing a company's roots towards CE: 1) the paradigmatic, metaphoric, and normative dimension (norms, values, visions, concepts), and (2) a descriptive, positive, and analytic dimension (tools, metrics, instruments, indicators, and measures) (Korhonen et al., 2018).

In the theoretical framework (See Figure 3) proposed by Bertassini et al., (2022)[3], an organizational culture oriented towards CE comprises soft (mindset, values, and behaviours) and hard (capabilities and competences) aspects, both visible (values, behaviours, and capabilities) and submerged (mindsets and competences). The soft building blocks shape an organization's identity and behavioral characteristics. They relate to the collective human behaviours within the organization. In contrast, the hard building blocks comprise technical aspects, such as the infrastructure, shared knowledge, technologies and the ability to implement strategies. Meanwhile, visible building blocks are observable, mappable and modifiable, making them targets for intervention during changes. Submerged building blocks, although sometimes perceivable, pose greater challenges for intervention and change.

Each building block interconnects with the other. Mindsets, deeply rooted in values, translate into daily behaviours. These behaviours manifest when combined with appropriate capabilities, encompassing both theoretical knowledge (qualification) and ability (know how to do). Capabilities evolve into competences through repeated application and support from attitudes (combination of value, mindsets, and behaviours—know how to behave). When this cycle produces satisfactory outcomes, all the building blocks are reinforced. This reinforcement act as a catalyst, guiding the organization toward a culture that is CE-oriented culture and fosters sustainable development in the long term.

Figure 3: The five building blocks for a CE-oriented culture change



Source: Bertassini et al., (2021)

[3] See appendix A for more details.

2.2.Overview of CE transition approaches

In the literature, several approaches (such as guides, process model, roadmaps, and step-by-step methods) have been published (academical and non-academical) to support transitions towards the CE. They are detailed in the following paragraphs.

Robinson et al., (2006) proposed a five-stage maturity roadmap (start-up, take-off, expansion, progressive, and sustainability) for implementing knowledge management in construction organizations to promote corporate sustainability. Roome & Louche (2016) introduced a four-step process model (identifying, translating, embedding, sharing) for enacting sustainability changes in organizations. This model features interactions between the steps, such as step 1 and 2 connecting to facilitating networks, steps 2 and 3 developing vision and concept internally via a network, and steps 3 and 4 implementing structures. The commitment to learn spans all steps.

Mendoza et al., (2017) developed the BECE, a step-by-step model designed to help businesses implement CE requirements. It includes ten steps, ranging from creating a CE vision to implementing and reviewing action plans. Jørgensen & Remmen, (2018) suggested activities for redesigning company processes towards CE, encompassing mapping, analysis, exploring changes, and implementing them in products, services, internal organization, and value chains. Leising et al., (2018) offered a model for developing circular building and supply chain collaboration, consisting of five main phases and corresponding activities. Wiesner et al., (2018) presented a four-step model for small and medium enterprises (SMEs) to manage change towards environmental sustainability. This includes designing, internalizing, implementing, and evaluating environmental sustainability.

Frishammar & Parida (2019) proposed a roadmap for circular transition, aimed at helping companies meet diverse objectives and proactively address sustainability. This roadmap encompasses four phases with specific goals, principles, activities and outcomes. Parida et al., (2019) described a two-stage process for ecosystem transformation toward a CE paradigm, focusing on readiness assessment and transformation with specific mechanisms. Chen et al., (2020) introduced a model integrating previous CE transition frameworks and structured in three main stages: without solution, with solution, implementation. Smol et al., (2020) proposed an approach for transforming municipal waste management in Poland towards CE, encompassing 13 activities.

Reim et al., (2021) provided a decision tree to guide companies in choosing CBMs, detailing steps and key routines for advancing through different maturity levels. Droeger et al., (2021) proposed a method to assess public sector organization’s progress in driving the CE

transition, involving CE elements, principles, and measurement targets and indicators. Manshoven & Gillabel, (2021) developed a serious game to educate about CE, involving ten rounds of decision-making under varying scenarios. Pieroni, McAloone, & Pigosso, (2021) outlined a four-step approach for CBM innovation, encompassing preparation, sensing, seizing, and transforming, each with specific activities and tools. Pieroni et al., (2021) proposed the Circular Economy Business Modelling Expert System (CEBMES), a detailed step-by-step approach for designing, configuring, and evaluating BM alternatives.

Prieto-Sandoval et al., (2021) introduced a five-step approach for integrating CE in SMEs, focusing on firm identity, diagnosis, planning, implementation, and assessment, with key questions for each step. Pigosso & McAloone, (2021) offered a self-assessment tool determine a manufacturing company's readiness for CE implementation. Hofmann & zu Knyphausen-Aufseß, (2022) suggested a set of capabilities and activities for firms to experiment with in creating new CBMs.

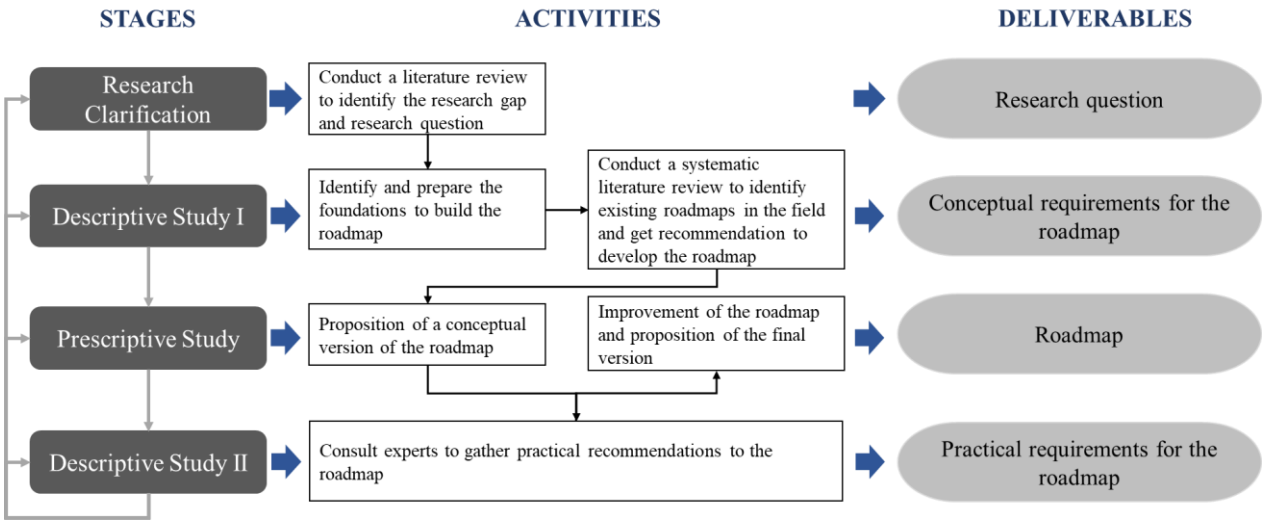
Regarding non-academic approaches, C2CBizz (2017) proposed a five-step method for transforming linear economy problems into business opportunities in the early stages of CE transition. The WBSCD (2017) outlined a five-step approach for maximizing impact on the triple bottom line through CE implementation. The British Standards Institution, (2017) provided guidelines with six principles for selecting CE indicators. WBCSD (2018) introduced a six-step guide for leaders to implement CE principles. The EU (2017) suggested the EMAS (Eco-Management and Audit Scheme) with five steps for monitoring and reducing environmental impact. Walker, (2017) proposed a ten-step method for sustainable development through change management. Arponen et al., (2018) proposed a roadmap for ecosystem-level CE implementation, divided into two phases with specific steps. EMF (2020) proposed a method for measuring companies' CE performance using a set of questions across eleven indicators categories.

Combining the theorethical foundations and main concepts presented in this section with the overview of existing CE transition approaches, and with insights from previous research in appedinxs A, B, C, and D, we used a multisptep methodology, as explained in section 3, to propose our cultural transition roadmap for CE implementation.

3. RESEARCH METHODS

To design and develop the roadmap, our research approach drew inspiration from the Design Science Research Methodology (DSRM) (Blessing and Chakrabarti, 2009). This approach is structures in four stages (Figure 4), and is elaborated upon in sub-sections 3.1 to 3.4. We proposed a cultural transition roadmap aimed at shifting the organizational focus from a traditional, organization-centric model to one centered on a circular business ecosystem. Given the extended timeframe for such a transition in organizational culture, the empirical testing of the roadmap was beyond the scope of this research.

Figure 4: Research approach for the roadmap development



3.1.Research Clarification

Through an exploratory literature review across interdisciplinary fields, including circular economy, change management, organizational culture, innovation management, and technological roadmaps, a research gap was identified. This gap is the absence of a structured approach to guide companies in their cultural-level transition journey towards CE. This exploratory review also helped in identifying complementary concepts and aspects from each field that could be integrated to develop the cultural transition roadmap. The identified gap necessitated an investigation into a research question: how can a guidance roadmap facilitate companies in their transition towards a CE-oriented culture?

3.2.Descriptive Study I

Descriptive Study I aimed to lay the foundations for building the roadmap. A SLR was carried out to identify previous studies proposing roadmaps, guidelines, or step-by-step approaches for CE transition, and to gather recommendations for developing our roadmap. The databases used were Scopus, Web of Science and EBSCO, as they comprehend the most relevant studies in the fields of engineering and business management. The selection criteria included articles, conference papers, and reviews published in journals and conference proceeding, and written in English. Additionally, grey literature sources (e.g., consultancy websites, corporate reports) were examined, along with a cross-reference analysis (i.e., look for a reference a study is citing). A total of 26 publications were selected for this study (see Figure 5).

Figure 5: SLR procedure

The selected publications were required to present an approach (guideline, step-by-step, process model) to guide companies in their transition towards CE. These publications, combined with others from the exploratory review, served as the basis for identifying the gap this study addresses. They also provided inspiration and essential criteria for proposing the conceptual version of the cultural transition roadmap. The conceptual requirements identified from these sources were considered foundational for the development of the roadmap, as shown in Table 2.

Table 2: Conceptual requirements for the cultural transition roadmap

Publication	Requirement (R)
(Ho & O'Sullivan, 2020)	R1 Provide a broad overall picture of how diverse innovation functions and relevant issues may be related to each other
	R2 Useful reference point of communication
	R3 Coherent structure and format
	R4 Integrated activities
	R5 Iterative format
(Tormo-Lancero et al., 2022)	R6 Supportive tool
(Rivero & Daim, 2017)	R7 Simple
(Arsova et al., 2021)	R8 Based on a multistakeholder perspective

3.3.Prescriptive Study

In this phase, the conceptual version of the roadmap was developed, characterized by specific features. Its architecture followed the format of a strategic roadmap, incorporating a layered representation divided into a timeline. This was accompanied by a table outlining a set of tasks necessary to achieve the outcomes promised by the roadmap. It consisted of three layers (organizational culture, business model and business ecosystem) encompassing 12 steps, 3 outcomes, and 41 tasks. Based on findings from the *Descriptive Study II*, detailed in sub-section 3.4, a practical and final version of the roadmap was also proposed. This final version, elaborated in Section 4, adopts a process structure and includes a set of tasks aimed at realizing the roadmap's promised outcomes. It is structured into 7 steps, with 1 outcome and 25 tasks.

3.4.Descriptive Study II

After identifying the knowledge gaps, we engaged in constructive research with experts to refine the roadmap. These experts, specializing in CE/sustainability and innovation management, were interviewed to lend a practical and effective format to the roadmap. The process was conducted in two stages.

Initially, we consulted practitioners for recommendations and inputs for developing the roadmap, subsequently proposing an initial practice-oriented version. Experts in CE/sustainability and innovation management were selected from various sectors, chosen for their intention to innovate towards CE, extensive experience in either CE or innovation management, and their willingness to contribute 30 min to 1 hour for an interview and provide feedback on the roadmap. Table 3 presents more details about the interviewed experts. These interviews took place from July to September 2022 and were semi-structured[4]. The data analysis

[4] See Appendix J to consult the questions used as the basis for the semi-structured interviews with the experts.

involved transcribing the interviews, coding, and identifying tasks and other requirements for the roadmap. We conducted content analysis (Dresch et al., 2015) of the qualitative responses from the interviews to support or refute the steps and tasks in the conceptual version of the roadmap. Finaly, the practical and final version of the roadmap was proposed in the Prescriptive study.

Table 3. Experts' Description

Expert	Position	Company	Experience
A	Founder & CEO	Alpha – CE and Sustainability Consultancy	11 years (CE/sustainability)
B	Executive Manager for Carbon Initiatives	Beta – Paper and Pulp	30 years (CE/sustainability)
C	Head of Sustainability and EH&S	Gamma – Engineering and Technology	17 years (CE/sustainability)
D	SGI Manager	Delta – Paper and Pulp	20 years (CE/sustainability)
E	Sustainability Consultant	Epsilon – Paper Manufacturer	5 years (CE/sustainability)
F	Founder & CEO	Zeta – Recycling and Remanufacturing	19 years (CE/sustainability and Innovation)
G	Research & Advanced Engineering	Eta – Vehicle manufacturer	8 years (Innovation & Smart Vehicle)
H	Co-Founder & CEO	Theta – Fashion and Textile	5 years (CE/sustainability)
I	Head of Global Innovation Management	Iota – Food manufacturer	2 years (CE/sustainability) and 16 years (Innovation)

4. RESULTS AND DISCUSSION

4.1.Roadmap Overview

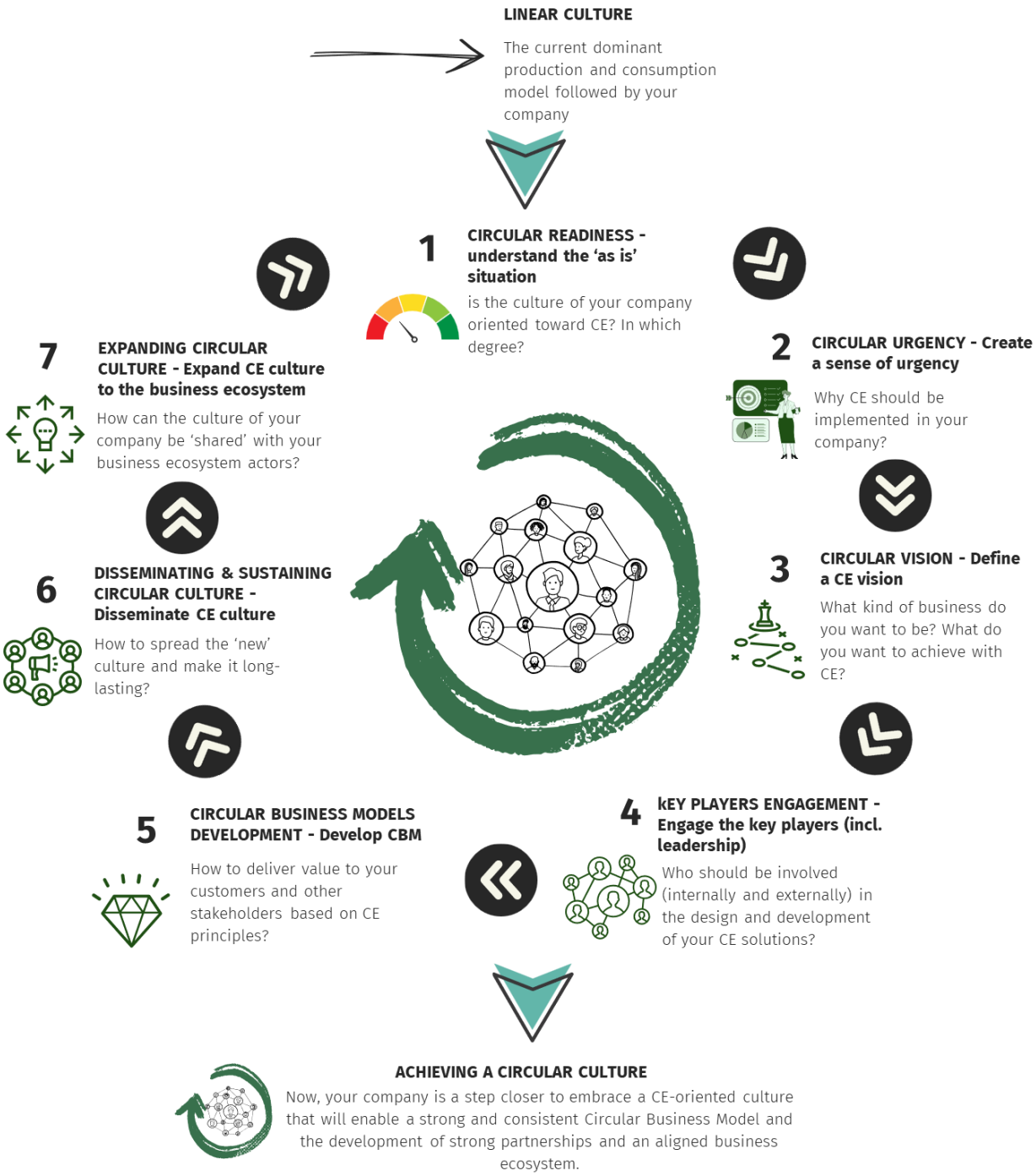
The roadmap proposed in this study is designed as a set of guidelines to facilitate the transformation of organizational culture towards one oriented around CE. While the focus is on OC, it is important to recognize that culture does not stand alone. It must be aligned with both the business model and the business ecosystem management to effectively support and drive the CE transition. Changing organizational culture is a lengthy and cyclical process, further complicated in the context of CE due to the shift from an "organizational/internal focus" to a "business ecosystem focus".

Figure 6 illustrates the seven steps that organizations must follow to guarantee successful planing and implementation of CE initiatives at the cultural level. To aid in navigating these steps, Table 4 was created, detailing the tasks to be undertaken. The specifics of Table 4 and the associated tasks are further elaborated in section 4.2.

Some companies inherently designed with a circular DNA, but majority of our global economy consist of companies with a linear DNA, which face challenges in transitioning to a more circular and sustainable society. Companies embarking on transition to CBM, especially PaaS models, sometimes fail because their foundational culture does not support the long-term implementation of CBMs and business ecosystem management. Another challenge is that these companies may not perceive the transition to CE as crucial, lacking both awareness and a mindset conducive to CE, as well as a culture oriented towards sustainable and radical innovations.

To start the transition towards a CE-oriented culture, an organization first needs to diagnose its current level of CE-oriented culture. We recommend using the CE-oriented culture readiness approach proposed by Bertassini et al., (2022). The application of this approach and an example of its use are available in appendix G. It is also vital to create a sense of urgency for implementing CE or to reinforce the reasons why CE should be adopted. This sense of urgency and the rationale for CE implementation can be gleaned from the discussions in the papers provided in appendix A and B. Moreover, understading the organization's values is a valuable tool in creating a sense of urgency, an the papers presented in appendixs G and F offer insights in this regard.

Figure 6: CE-oriented culture transition roadmap



Whit the circular awareness established within the company; it is time to develop the company's vision for future CE development. In parallel and complementaring the previous steps is the engagement with internal and business ecosystem, crucial for creating a comprehensive circular system. The company's defined vision is implemented through a CBM developed to meet customer needs and stakeholders' expectation in a circular and sustainable way. Then, it is important to disseminate and sustain the newly established CE-oriented culture,

along with successful changes and initiatives. Once the company can sustain their own initiatives towards a CE-oriented culture, it should spread and expand this culture and its initiatives to other process, business units, and business ecosystem stakeholders. Ultimately, companies will embrace a CE-oriented culture that enables a strong and consistent CBM, and fosters the development of strong partnerships and aligned business ecosystem.

4.2.Steps and Tasks

Table 4 provides an overview of the steps and tasks that companies should undertake to transition towards a CE-oriented culture. It includes detailed description of each step and task, laong with quotes from interviewed experts to emphasize the practical importance of each.

Table 4. Roadmap Steps and Tasks

Step	Task	Source	Support publications
Circular Readiness	Identify the level of readiness for implementing a CE-oriented culture.	literature	Bertassini et al., (2022)
Circular Urgency	Identify the reasons for and benefits of implementing CE in your company.	literature & experts	Hopkinson et al., (2018); Peterson et al., (2021)
	Create a sense of urgency and awareness for implementing CE.	literature & experts	Bertassini et al., (2021a); Bertassini et al., (2021b)
Circular Vision	Define/update a vision for company's future, oriented towards CE.	literature & experts	Lewis et al., (2017); Rocha et al., (2019)
	Define the role of sustainability in the company's strategy.	literature & experts	Hristov et al., (2021); Egels-Zandén et al., (2015)
	Plan short-term 'wins' (less complex and short-term projects).	literature & experts	van Buren et al., (2009)
Key Players Engagement	Identify and recruit key internal actors (change agents) with CE knowledge.	literature & experts	Bertassini et al., (202c1)
	Hire people with CE-oriented values and competences.	literature & experts	Barboza et al., (2021a); Barboza et al., (2021b)
	Build multidisciplinary teams for CE actions.	literature & experts	
	Identify ecosystem actors for potential initiatives.	literature & experts	Bertassini et al., (2021c)
	Define roles and align expectations among ecosystem actors.	literature & experts	Salvioni et al., (2020); Santa-Maria et al., (2021)
	Seek external investment and partners for CE solutions.	literature & experts	Santa-Maria et al., (2021)
	Create a trustful environment for knowledge sharing.	literature & experts	Santa-Maria et al., (2021)

Step	Task	Source	Support publications
Circular Business Model Development	Design/adapt and develop a circular business model.	literature	Bertassini et al., (2023); Galetti et al., (2022a); Galetti et al., (2022 b)
	Create independent business units and new internal functions.	literature & experts	
Disseminating and Sustaining Circular Culture	Develop leaders as role models for CE transition.	literature & experts	Qaisar et al., (2020); Johnson et al., (2008)
	Set up artifacts that stimulate an innovative workspace.	literature & experts	Dombrowski et al., (2007)
	Create opportunities for all to evolve and validate their competences.	literature & experts	Santa-Maria et al., (2021)
	Plan top-down and bottom-up changes	literature	
	Develop/adapt performance indicators for monitoring CE progress.	literature & experts	Rossi et al., (2020) Arantes et al., (2022)
	Implement a communication program.	literature & experts	Goodman et al., (2004); Butt et al., (2016)
	Establish circular centers for education programs.	literature & experts	Reddy et al., (2019); Bianchi et al., (2021)
	Document lessons learned, learn from others and produce more changes.	literature & experts	Siebenhüner et al., (2007); Bianchi et al., (2021)
Expanding Circular Culture	Replicate and share good practices and lessons learned developed in your company to key partners and other business units	literature & experts	Santa-Maria et al., (2021)
	Build networks and collaborative practices to spread CE culture among business ecosystem actors.	literature & experts	Santa-Maria et al., (2021)

4.2.1. Circular Readiness

This step involves understanding and evaluating (diagnosis) the company's current readiness level for implementing a CE-oriented culture. While the roadmap focuses on culture, a comprehensive 'as-is' situation diagnosis in business model and business ecosystem dimensions[5] is also recommended. This involves understanding contextual and influential factors that enable or hinder CE adoption. The task here is to *identify the readiness level for a CE-oriented culture*, using the approach developed by Bertassini et al., (2022), which evaluates five dimensions of CE presence in company culture: values, mindset, behaviours, capabilities, and competences (the detailed tool can be seen in Appendix G).

[5] Although it is important, those complementary diagnosis are not comprehended in this study because there are a lot of more detailed studies focused just on that: (Parida et al., 2019; Pieroni, McAloone, Borgianni, et al., 2021; Pigosso & McAloone, 2021)

In addition to tool application, companies can organize workshops with key internal players to answer questions about their current value proposition, vision, mission, goals, and how circular/sustainable aspects are functioning within the organization. The diagnosis should define short, medium, and long-term objectives for the implementation plan, ensuring alignment of circularity/sustainability efforts with business strategy. Understanding the readiness level is crucial, but using this information to align the culture with a business strategy that adheres to CE principles is even more vital. This clarity will direct the entire transition process.

Readiness assessment is a fundamental step that enables decision makers to be sensitive to new information about the company, identify novel business opportunities related to CE and understand their capacity to seize these opportunities (Parida et al., 2019; Hmieleski, Corbett, & Baron, 2013; Ray & Cardozo, 1996). Moreover, transitioning towards CE necessitates a re-evaluation of the company's current state, as well as broader economic and societal conditions (van Langen et al., 2021).

4.2.2. Circular Urgency

The goal of this step is creating a sense of urgency in individuals about to transitioning to a CE, elucidating the reasons for and benefits of adopting CE. The primary task involves *identifying the reasons for implementing CE in your company and understanding its benefits*. This clarity is crucial for comprehend discussions about CE, including its rationale and potential advantages. Expert E highlights that embracing CE requires shifting from a traditional linear perspective to a 'circular vision', challenging ingrained linear thinking patterns. This new outlook involves reevaluating resource utilization, allocation, and sustainability.

Leaders or the change agents advocating for CE should emphasize its benefits and introduce a novel perspective on the product, company operations, and sustainable practices. Expert A underscores the importance of showcasing CE's benefits, such as financial returns and process optimization, to prevent misconceptions that equate environmental sustainability with mere waste management. Expert B adds that it is vital to clearly define the value CE will bring to the company, acknowledging that it might initially reduce volume in some economic aspects.

Understanding what CE entails for your company is crucial, as its application varies across different markets and segments. Benchmarking is a valuable tool for illustrating the importance of sustainability and CE in an organization.

The second task is *creating a sense of urgency and awareness for implementing CE*, especially in companies lacking a circular and sustainable mindset. The potential benefits identified earlier can be leveraged to engage stakeholders and encourage the exploration of CE solutions. Expert A emphasizes the importance of aligning the company's mindset and vision with CE principles, noting that developing this mindset is a continuous process crucial for initial steps towards CE. Expert B suggests that creating a sense of urgency involves extensive internal communication to clarify the benefits of sustainable solutions, emohasizing the importance of materiality and impact beyond mere marketing.

The standard BS 8001 (BSI, 2017) presents a framework for CE implementation, starting with understanding and building awareness about CE and its relevance to your company. This step is foundational for cultivating a mindset attuned to circular values and behaviors. It is also essential to recognize CE's broader implications, including the need for a collaborative business ecosystem. A company must not overlook stakeholder value creation, understanding their interests, advantages, and competences, and involving them in the process. van Langen et al., (2021) observed that increasing awareness, sensitivity and care regarding nature and people is a recurring theme in workshops, signaling the urgency of building a CE grounded in new values. Successfully executing this step can lead to a committed and aligned team, ready to embrace a culture oriented towards CE.

4.2.3. Circular Vision

The goal of this step is to build a long-term vision for CE implementation, aligning it with the strategic goals of the business. Establishing a vision can be achieved through formal statements, policy declarations, or consistent messaging from company leaders. This vision acts as the central point from which sustainability and CE initiatives extend throughout the organization. To *define/update a vision for company's future, oriented towards CE,* a company should consider how it wants its culture and strategy (e.g., purpose and ambition, business imperatives, culture archetypes, values, behaviours) to evolve. Concurrently, specific goals and targets to expand the company's CE presence are set.

A clear vision is crucial for engaging internal and external stakeholders and for developing a plan to harmonize the culture across business units and the broader business ecosystem. Expert G points out the challenges of cultural alignment in large companies with diverse locations and practices, emphasizing the need for leaders to effectively communicate corporate culture on a personal level. For instance, Company Gamma's 2025 vision integrates

CE as a strategic goal and part their BM. Their goals include redesigning products for end-of-life reuse and giving products a second life rather than simply recycle them. Gamma has shifted from focusing solely on technically and economically feasible solutions to designing products with value optimization in mind, aiming to fully utilize materials within their processes or in the other value chains by 2025. Expert H stresses the importance of understanding a business's purpose, whether it is maximizing shareholder value or societal value. The growing focus on societal impact is becoming a necessity rather than an optional attribute for businesses.

Another critical aspect is *defining the role of sustainability in the strategy of the company*. A practical approach is to use backcasting (Vergragt; Quist, 2011), which involves setting a goal and determining what actions are necessary today and tomorrow to achieve that goal. Expert E highlights the inseparability of CE and sustainability, emphasizing the need for a cultural shift within the company to embed these principles.

Particularly for resource-limited companies, such as small and medium size companies, *planning short-term wins* is vital to maintain motivation to continuously and prioritize CE opportunities. Balancing less complex, short-term projects with large ones can facilitate cultural change and continuous improvement. An example is company Delta's collaboration with Starbucks in Brazil to recycle cups, demonstrating the benefits of waste management, raw material reduction, cleaner production practices, and associating sustainability with cost reductions and environmental improvement.

4.2.4. Key Players Engagement

The goal is to engage both internal (from top to bottom) and business ecosystem actors in the design and development of CE solutions. Engagement is deeply rooted in culture; beginner organizations in the CE journey typically focus on internal stakeholders, while more advanced ones extend CE culture to the entire business ecosystem. This engagement across various levels (micro, meso, macro) is crucial for transitioning successfylly to a CE- oriented culture and ensuring a multidisciplinary approach.

The process begins by *identifying and recruit key internal actors (change agents) with CE knowledge*. This required individuals with values and mindsets aligned with CE. Tools proposed by Bertassini et al., (2021c), and guides Barboza et al., (2021a, 2021b) can assist this process. If lacking in-house expertise, companies may *recruit new employees who embody circular values*. Expert G emphasizes the importance of hiring people with a proactive and collaborative attitude. Conversely, being a sustainable and circular company can attract talent,

as noted by Expert F, who observes that people are often drawn to companies due to their commitment to sustainability and CE.

Building multidisciplinary teams is also essential. For instance, at Compay Gamma, specialists in sustainability, regulation, product development, and taxation collaborate on CE implementation, ensuring that all departments are involved, not just the sustainability team.

The fourth task is *identifying key ecosystem stakeholders for CE initiatives.* Bertassini et al., (2021c) offer guidance here as well. Expert B discusses the importance of collaborative innovation involving various ecosystem players, from raw material producers to startups with potential solutions. This collaboration is vital for developing effective CE projects.

Consulting Alpha provides an example of a Brazilian energy seeking partners for the recovery and recycling of solar panels. This approach involves analyzing key partners and aligning them with the company's vision. Stakeholder engagement, as Salvioni & Almici, (2020) suggest, is crucial for fostering a culture that upholds sustainability principles and meets economic, social, and environmental expectations. At Company Zeta, stakeholder roles in a circular value chain are clearly defined to coordinate multi'stakeholder processes. This includes identifying roles from material collection to recycling and sales, ensuring all entities align within the circular chain.

Defining the role of each actor, set a common understand and align expectation is essential. This means, clearly define the responsibilities of each player and the shared risks, set a common understand and align expectations and value proposition aiming of balancing goals that can sometimes be in conflict. Expert E highlights the importance of complementary perspectives among ecosystem partners. Differign viewpoints, as noted by Beland Lindahl, (2008), can lead to varied approaches to the same problem. Cramer, (2020) and Rauschmayer et al., (2015) argue that the path to CE should be collaboratively defined by the actors involved, avoiding the pitfalls of conventional, unsustainable approaches. In line with the transition management literature, only includes actors that expressed their willingness to engage proactively in CE and are able to transcend organizational boundaries (Sengers, Wieczorek, & Raven, 2019). This measure can be used to avoid the problem of becoming locked in conventional innovation trajectories such as low-grade recycling (Korhonen et al., 2018).

Epsilon's experience with circular packaging in Brazil illustrates the challenges and complexities of engaging diverse stakeholders, especially in fragmented industries like post-consumer paper scrap. Similarly, Gamma's approach to reverse logistics involves partnering with external entities, manafing shared responsibilities and risks under Brazil's environmental policies.

The sixth task involves *seeking external investment and partnerships for CE solutions*. FINEP in Brazil serves as an example of agency supporting innovation in this realm. Expert A notes the growning trend of investments in ESG-focused solutions, while Expert C emphasizes the importance of sectoral agreements and collaborations.

Finally, *establishing a trustful environment for knowledge sharing* is pivotal. Expert G points out the need for trust to facilitate sharing and collaboration. The complexity of the CE transition, as mentioned by Experts F and G, requires understanding each stakeholder's perspective and fostering a dynamic, evolving ecosystem. In summary, engaging key players at all levels, both internally and within the wider business ecosystem, is fundamental to building a CE-oriented culture. This involves identifying and aligning stakeholders, creating multidisciplinary teams, and fostering a collaborative and trustful environment.

4.2.5. Circular Business Model Development

The goal of this step is to develop a CBM that addresses both customer needs and stakeholder expectations. The first task involves *designing/adapting and developing a PaaS business model.* It is crucial to remind leaders that the organizational culture should be aligned with the BM and vice versa. The BM must incorporate stakeholder's perspectives, including customers' needs, within the CE objectives. Appendix C provides a list of good practices for implementing PaaS, along with an example from a battery-as-a-service company. Additionally, appendix D outlines common barriers to PaaS implementation.

The second task focuses on *creating independent business units and establishing new internal functions*. An example from company Iota as shared by Expert I, illustrates this approach. Within Iota, Expert I oversee business and innovation in market intelligence. The company has a structured approach to working with startups in the innovation process and exploring new business areas. The independent business untis are tasked with managing the innovation pipeline. While the main company's 'new business and innovation' department maintains an overview of these units' activities and provides catalytic support, when necessary, the business units themselves bear the primary responsibility.

Iota has strategically separated new business innovation from other business areas to prevent complications and challenges that can arise from blending them with larger corporate structure. Expert I elaborate on the complexities of innovation within this framework, particularly in differentiating investment strategies for new ventures compared to core business activities. The challenge lies in establishing business cases for these new ventures, which often require a different approach to investment justification and financial planning. This necessitates

close collaboration with controlling departments to develop accurate business case calculations that may not fit traditional models.

4.2.6. Disseminating and Sustaining Circular Culture

The goal of this step is to cultivate and sustain a culture oriented towards CE. Task one involves *developing leaders as role models and key agents in the CE transition*. Expert E emphasizes the critical role of leadership in championing CE, particularly in allocating resources and setting priorities. Leaders should be adaptable, open to employee-drive innovation, and effective in communicating the vision of CE. Expert A notes that the mindset of leadership is crucial for CE implementation; if leaders are not aligned with CE principles, it can demotivate employees and hinder progress.

Leadership plays a crucial role in integrating CE into the company culture by defining expectations and operational methods related to CE. This integration helps make CE a part of daily company life and culture. Leaders must outline a clear direction towards CE and provide necessary resources and deadlines to achieve related targets and goals. They need to be actively engaged, communicate frequently about CE, and provide training for employees at all levels. It is also important for leadership to inspire the workgorce, ensure understanding across the comoany, and delegate roles based on the expertise of each individual, considering both internal and external stakeholders.

In addition to leadership serving as an example, it is important to identify influencers among the employees who can help disseminate the CE culture and behaviors, especially to those resistant to change or struggling to grasp the vision and benefits of CE within the company. As Expert I indicated, integrating leadership in this process is vital because without their involvement, necessary resources may not be allocated, stifling innovative efforts.

Expert A shared an example: in a large company, publicly traded company, even within a hierarchical structure, experts have the freedom to work autonomously. This autonomy in decision-making accelerates progress. Conversely, in another company with a similar structure, there is more centralization and less autonomy for experts, leading to slower project development. Thus, the autonomy granted to teams significantly influences the development of functions and actions toward CE.

Gamma provides another example, having an internal focus on CE innovation: the company frequently calls for CE ideas and hosts several innovation events. Employees are encouraged to propose ideas with environmental and social impact. Delta, on the other hand, organizes an environmental week to educate employees about CE, encouraging them to apply

these concepts at work and home. Expert F stressed the importance of leadership and competence in implementing CE at the cultural level, noting that it is challenging for employees to change the mindset of decision-makers. Therefore, having competent managers in decision-making positions is crucial for the swift adoption of CE practices.

Setting up artifacts that stimulate an innovative workspace is also vital. This involves establishing a culture that allows for trial and error in developing and proposing CE solutions, fostering a 'just do it' attitude. Expert I emphasized the importance of having dedicated spaces for innovation and taking a practical approach to innovation projects, rather than getting bogged down in theory. Iota, for example, uses various tools for different kinds of innovation: building an innovation-friendly culture, maintaining open and transparent communication, and collaborating with other departments like I.T. and digitalization. They have a School Campus where innovation is visibly encouraged, and a designated room that physically represents how innovation can be fostered. Epsilon's approach to eco-efficiency studies, which are based on life cycle analyses, provides a more structured methodological path for robustly addressing problems. When it comes to reverse packaging logistics within the circularity concept, the company adopts a more tentative approach, recognizing the unique needs of each customer.

The third task is *creating opportunities for everyone to evolve and feel confident in their competences. D*eveloping a recognition system for those engaged in the CE transition is essential, as is involving employees in transition processes and occasionally restructuring roles. Rewarding innovation efforts and contributions based on their impacts and allocating time for employees to generate new ideas are crucial. Expert F mentioned the importance of employees feeling involved and motivated, while Expert G highlighted the anxiety experienced by experts transitioning to new fields, emphasizing the need to communicate their continued relevance and capabilities.

The fourth task involves *planning both top-down and bottom-up changes to empower and encourage employees to contribute new ideas across the company*. Encourage employees to involver in pre-specified innovation project of their interests (short-term), organize an innovation contest and setup the plan for implementation (medium term), integrate innovation activities as a part of their day-to-day operation (long term).

The fifth task is to *create/adapt performance indicators to the circular context of the organization considering cultural factors to monitor the evolution of CE in the company*. *L*eader and managers should consider developing and using not only economic indicators but also social and environmental to measure the success of a CE project. The CE performance indicators for the social, environmental, and economic spheres constitute an essential part of

establishing direction, and they are typically linked to the strategies named in the Sustainability Strategy. The KPIs selected for measuring organizational, operational, or project circularity performance measurement should be meaningful from a sustainability perspective, easy to communicate and understand, easy to measure, and useful for decision making. Expert B highlightes the challenge of educating individuals with limited resources to differentiate materials for recycling, underscoring the importance of social indicators. Expert D pointed out the social aspects of CE, such as creating regulated work environments in vulnerable communities.

The sixth task is *developing and implementing a communication program* to ensure transparency and engagement. Communicating the vision and strategies established by leadership, along with the Sustainable Strategy, to all internal and business ecosystem actors is necessary. Expert H emphasized the importance of storytelling in communication, while Expert I noted the significance of transparency to prevent loss of resources.

The seventh task is *establishing circular centers for education programs* to train and educate employees at all levels, developing both their technical knowledge and skills for CE. Expert A highlighted the importance of combining hard skills like life cycle analysis with soft skills such as mindset and awareness.

The last task involves *documenting lessons learned, learning from others, and producing more changes*. This includes getting inspired by examples from other companies, learning from previous errors, and assessing potential risks. Evaluating and documenting lessons from the first implementation cycle can strengthen and improve future initiatives. Promoting learning and communication using visible measurement systems and dialogue to identify improvement opportunites is key. Expert G emphasized the importance og being open to learning from others as part of collaboration.

4.2.7. Expanding Circular Culture

The goal of this step is to spread the awareness and CE culture to beyond the company, shifting focus from the company as the central entity to fostering a CE culture within the broader business ecosystem. This can be acheived by *replicating and disseminating good practices and lessons learned developed from within the company to key partners and other business units*. One effective approach is to act as environmental champions, educating key business partners about new environmental commitments and the underlying reasons for adopting CE practices.

The second task involves *building networks and collaborative practices to futher spread the CE culture among the business ecosystem actors*. The aim here is to foster learning and

actions centered around the CE vision. Supporting the development of partners in their journey towards CE is crucial, and this can be accomplished through investments and collaborative efforts in pilot project and training programs. Transparency is essential in these collaborations to build and maintain trust.

An innovative approach includes the acceleration of startups or spin offs, especially when ideas deviate signifanctly from the company's core business. In such cases, it may be beneficial to either create spin-offs or partner with startups that align with the company's innovation fiels. This allows these new ventures to address challenges more independently, whithout the intense pressure typically associated with the core corporate environment.

Working directly with customers is another key strategy. Expert I ellabortes on Iota's approach, which involves engaging primarily in Business-to-Business (B2B) interactions. This includes conducting innovation workshops and open innovation sessions with customers and suppliers, and gaining insights from consumers through testing. This strategy aims to mitigate the risks associated with innovation by involving various partners. Iota's involvement with startups and the establishment of new organizations, such as the Food Solution Center, exemplifies this approach. These centers are dedicated to providing plant-based solutions for the food service industry and are fully owned by Iota to allow greater operational freedom and independence. While they have access to Iota's production facilities, their organizational structure is designed to be more autonomous, with a defined budget and the liberty to make swift, independent decisions. Alongside startups, collaboration with universities and city innovation hubs also plays a significant role in Iota's strategy.

5. CONCLUSIONS

This research was inspired by the recognized need for collaboration and the right personnel to enable CE transition. This need was identified through the study of existing literature and observations of various companies. Central to any business is not the product it sells, but the people or stakeholders impacted by its solutions. This becomes even more evident in a CBM like PaaS, where costumers no longer own a product but instead pay for the result or experience that the solution offers. To effectively implement a PaaS model, integration with the value chain is essential, not only for the company providing the solution and the customer but also for all key players and stakeholders involves, directly or indirectly, in this business ecosystem. A circular soluiton heavily relies on the right people, culture, mindset, values, behaviours, and competences. These aspects have often been overlooked by previous research and even by companies themselves. Commonly, the focus during a transition to a CBM is on developing or acquiring the necessary technologies and technical expertise for CBM implementation. Consequently, the cultural foundation essential for sustaining these changes often does not exist, leading to the failure of circular innovation efforts. This gap in understanding and approach was the motivation behind this research.

The main goal was to propose a roadmap (a set of guidelines) to guide companies on their journey towards integrating PaaS into their organizational culture. We achieved this by proposing seven steps and twenty-five tasks as a guide for companies to implement the circular business model, PaaS, at the cultural level (as explained in section 4). In addition, we addressed three RQs: RQ1 - Is there a culture, i.e., a set of shared values, which reflects circular economy goals and principles?; RQ2 - what are the building blocks of a CE-oriented culture?; RQ3 - how can the transition towards a circular business model be supported by a CE-oriented culture? These questions were explored through complementary papers, collectively forming the basis for the roadmap development. First, we developed a theorethical framework and identified literature and practical challenges in implementing/developing a CE-oriented culture. The papers in Appendix A and B were developed for this purpose. Second, we identified a list of good practices for implementing PaaS business models, as presented in the paper in Appendix C, and the barriers and challenges to implementing PaaS business models, as discussed in Appendix D. Third, we identified organizational values that represent a circular organization, as demonstrated in Appendix E and Appendix F. Fourth, we developed an assessment approach to measure readiness for implementing CE at the cultural level, presented in Appendix G.

Finally, two additional and complementary papers were developed during the roadmap proposition process. We uncovered new connections that were important: the applicatioan of mass customization concepts in implement CE, detailed Appendix H, and the alignment of business model innovation, organizational culture, and business ecosystem management for CE innovation, as outlined in Appendix I. Thus, all the expected propositions of this research were achieved.

In the remainder of this section, we discuss the theoretical, managerial, and political implications generated by this research. Moreover, we presented the limitations and opportunities for future research.

5.1.IMPLICATIONS

The CE-oriented culture transition roadmap was developed based on the identification of seven key steps necessary for linear companies transitioning towards a CBM. These steps are: (1) diagnosis; (2) sense of urgency; (3) vision; (4) engagement; (5) development; (6) disseminate and sustain; (7) expand. A total of 25 tasks were proposed to support the achievement of each of those steps. This roadmap offers crucial guidance for successful transitioning to CE at the cultural level. It enhances understanding of strengths and gaps in CE implementation at the cultural level through a diagnosis based on cross-functional efforts within a company. In addition, the roadmap allows companies to plan relevant transition paths.

By providing guidance and proactive strategies for implementing CE at the cultural level, the roadmap represents a concrete proposal to direct linear companies towards CE-thinking. This strategic approach to business is imperative for CE needs to continue playing a significant role in achievning the ambitious targets set for the sustainable development goals (SDGs) in society. However, on top of adequate tools, several conditions must be in place to encourage linear companies to embrace change.

Regarding the development of the CE concept and application, this research contributes to maturing the field and lays a foundational stone in the path of CE advancement. From a theoretical and academic perspective, this research is among the first in the field of CE to delve into the influence and importance of the 'soft side' and organizational culture in transitioning towards CBMs. It addresses numerous gaps identified by previous CE researchers regarding the behavioral and cultural factors influencing CE implementation and integrates different disciplines to underscore the multidisciplinary nature of CE and sustainability.

As for managerial implications, this research provides leaders with access to a roadmap filled with guidelines, enabling them to incorporate CE into their agenda more effectively, considering the softer aspects of CE implementation. It also contributes to the ESG (environmental, social, and governance) agenda by positioning people, culture, and governance as essential elements for CE transition. Furthermore, it offers a means for leaders to achieve several SDGs: SDG 4 (Quality Education) through influence in the business ecosystem, including local communities; SDG 8 (Decent Work and Economic Growth) by enhancing revenues through circular solutions and promoting decent work conditions; SDG 9 (Industry, Innovation, and Infrastructure) by building resilient infrastructure through continuous innovation; SDG 12 (Responsible Consumption and Production) by altering production patterns and influencing new consumption behaviors; SDG 13 (Climate Action) by reducing carbon footprints through business model changes; and SDG 17 (Partnerships for the Goals) by integrating various stakeholders in the pursuit of a more sustainable and circular society.

Politically, the findings of this research can guide public policies in various dimensions, including investment in professional training with a systemic view for effective sustainability implementation. This involves establishing investment agendas to develop professionals equipped to handle the challenges and complexities of sustainability and CE.

5.2.LIMITATIONS AND FUTURE RESEARCH

The main limitations observed are the currently limited scope of the roadmap in the organizational culture aspect (that was chosen in order to go deeper in an important aspect to develop CE instead of a broad roadmap), the lack of empirical test of the roadmap with potential users and companies, and a limitation on the variables identification, that means that the roadmap in its current form is just to aware the audience that there is inumeorus aspects that should be more investigated and detailed in order to develop a CE-oriented culture.

As future research opportunities we identified:

1. Expand the roadmap scope and consider (besides the organization culture) the business model and business ecosystem layer in details. Such an expansion of the scoping for the roadmap should be carried out with the intention of retaining as many of the current cultural aspects as possible, to preserve comparability, whilst obviously having to change some steps and tasks to be more relevant for the new scope.

2. Explore the roadmap for specific sectors of the economy, mainting as many of the current aspects as possivel, to preserve comparability.
3. Use longitudinal case studies or action research to apply the roadmap in companies and analyze the transition of the company and the applicability of the roadmap during the time.
4. Compare different and international context of organization understanding the law and political side.
5. Expand the roadmap to integrated the regenative system and business models as a powerful driver to the creation of a CE model in the cultural level.
6. Development of a meta-model that integrates the different cultures (circular, digital, innovation, data-driven) in a single framework highlighting the overlaps, differences and complementarities of each one.
7. Development of quantitative indicators that allows the measurement of qualitative actions, such as culture alignement and social aspects of CE implementation.

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APPENDIX A – PAPER 1

Bertassini, A. C., Ometto, A. R., Severengiz, S., & Gerolamo, M. C. (2021). Circular economy and sustainability: The role of organizational behaviour in the transition journey. Business Strategy and the Environment, 30(7), 3160-3193.

Title: Circular Economy and Sustainability: the role of Organizational Behaviour in the transition journey

Abstract

Implementing CE requires complex and dynamic changes in technical and behavioural aspects. Few studies spend efforts to understand the organizational behavioural side of CE transition. Thus, this study proposes a theoretical framework that addresses the requirements for the transition towards CE from the organizational perspective. We conducted a systematic review aiming to identify the relations between CE and Organizational Culture. As result, we developed a theoretical framework composed of five building blocks (mindsets, values, behaviours, capabilities and competences) that guide the transition toward a CE-oriented culture aiming to achieve sustainability in business. We also identified several gaps for future researches. We concluded that the framework could enrich the literature discussed in the field and be used by practitioners for the identification of paths to implement CE from the organizational culture perspective. In addition, the use of this framework could lead to the achievement of Sustainable Development.

Keywords: Circular Economy, Change Management, Organizational Behaviour, Organizational Culture, Sustainability, Sustainable Development.

1. Introduction

The technological advances have created an ever-changing environment that has pushed for the establishment of continuous innovations. A diversity of factors and aspects exist that stand out those innovations. Culture (individual, organizational and social) is one of them and is a key element to the development of innovations towards Circular Economy (CE) in order to achieve sustainability. CE has been proposed as very promising concept to guide the achievement of sustainability (Barreiro-Gen & Lozano, 2020; Lozano, Bautista-Puig, & Barreiro-Gen, 2021). Creating more sustainable societies requires new mental attitudes (mindsets) capable of breaking paradigms and able to deal with complex, adaptive, and unpredictable behaviour of ecosystems (van der Brugge & van Raak, 2007). Sustainability through CE only will be fully achieved if implemented based in an ecosystem and holistic perspective which gives equal

attention for all relevant stakeholders and business models combined in order to achieve a common goal (Khan, Daddi, & Iraldo, 2020; Konietzko, Bocken, & Jan Hultink, 2020). The ecosystem perspective has a systemic logic in which companies co-evolve cooperatively and competitively around interactions while redefine their business capabilities (Adner, 2006; Parida, Burström, Visnjic, & Wincent, 2019). Thus, changes in one organization will reflect in changes in the way organizations interact with each other. This reflects in resilient and collaborative business ecosystems able to promote deep changes in society.

The transition towards CE is a continuous state of adaptation, breaking paradigms, reviewing actions and operations (Kjaer, Pigosso, Niero, Bech, & McAloone, 2018); redesign structures and procedures (Ritzén & Sandström, 2017); and reinventing mindsets (CNI, 2018; Dufva et al., 2016). It involves changes in different levels of the organization, such as firm-wide traits (purpose and structure, shared values and beliefs); functional level (processes and systems), and individual level (individual value, beliefs, motivations) (Zollo, Cennamo, & Neumann, 2013). In order to achieve long-lasting changes and institutionalize CE, current organizational 'business-as-usual' cultures need to be challenged beyond technological or managerial systems (Lozano, 2007). The organizational culture tailored to innovation towards CE is a key element and implies a paradigm shift in the way the processes and activities have been administered in the organization. Shift to this 'new' form of governance towards a CE-oriented culture implies change in cognitive frames, shared values, and even emotional attachments to organizational identity (Bansal, 2003; Zollo et al., 2013). Thus, Change Management (CM) theory can be used as a support to conduct the required changes in the organizational culture in order to achieve circularity and consequently, sustainability. CM can be used as a toolbox to conduct changes in the states that organizations undergo in the transition process (the old state, the transition state, and the new state), considering soft aspects, such as Organizational Culture.

Soft aspects of business management are essential for organizations succeed in the transition towards CE. The human-focused dimensions, such as culture, positively affect the adoption of CE business models at the company level (Chiappetta Jabbour et al., 2019). Various authors expressed in their studies the importance to understand, change and/or make adequate the organizational culture to implement CE (Bashir & Verma, 2019; Bustinza, Gomes, Vendrell-

Herrero, & Tarba, 2018; Isensee, Teuteberg, Griese, & Topi, 2020; Ketprapakorn & Kantabutra, 2019). Norms, values, visions, concepts, tools, instruments, and indicators should be checked and/or adapted in order to CE become a paradigm in which industrial production and consumption will change in its roots (Korhonen, Honkasalo, & Seppälä, 2018). Despite the importance of soft aspects in the transition towards CE and all the efforts on developing the CE literature, organizational behaviour are little explored (Chiappetta Jabbour et al., 2019; Korhonen, Nuur, Feldmann, & Birkie, 2018). The majority of studies are related to hard factors, such as innovation in business models (Bocken, Schuit, & Kraaijenhagen, 2018; Frishammar & Parida, 2019), circular practices (Fischer & Pascucci, 2017; Winans, Kendall, & Deng, 2017), implementation of product-as-a-service business model, its barriers and benefits (Pagoropoulos, Pigosso, & McAloone, 2017; Tukker, 2015), circular metrics (Rossi, Bertassini, dos Santos Ferreira, do Amaral, & Ometto, 2020; Saidani, Yannou, Leroy, Cluzel, & Kendall, 2019) and public policies (Esposito, Tse, & Soufani, 2018; McDowall et al., 2017), leaving aside soft factor such as organizational culture. Few authors highlight the need for changing organizational culture for the CE development (Muranko, Andrews, Newton, Chaer, & Proudman, 2018; Wastling, Charnley, & Moreno, 2018).

There are few studies in literature addressing specifics aspects of soft changes for a more circular model, such as Chiappetta Jabbour et al. (2019) who developed a theoretical framework that conceptualizes Green Human Resources Management for the CE. Lewandowski (2016) included a block of adoption factors, which considers the organizational capabilities, such as organizational culture and human resources as important elements the proposition of Circular Business Models (CBM). Sousa-Zomer, Magalhães, Zancul, Campos, & Cauchick-Miguel (2018) identified that the implementation of the product-as-a-service business model requires mindsets change. EMF (2019) presented a set of competencies needed to leverage the CE development in specific business functions.

Korhonen, Honkasalo, et al. (2018) argument the current CE theory does not explore the basic assumptions concerning values, societal structures, and cultures. Korhonen, Honkasalo, et al. (2018) also affirm that issues related to organizational culture and the reluctance to adopt new modes of behaviour remain unexplored. Pieroni, McAloone, & Pigosso (2019) highlight that a gap in business model innovation for CE is the development of researches related to normative and people change management aspects such as values (individual, organizational, societal), organizational culture, mindsets, effective communication and leadership.

An expressive number of companies that foster activities towards CE seek to duplicate well-succeeded business models. However, without the right mindsets it will result in unsuccessful changes. As expressed by Bonchek & Libert (2017) we should change our mindsets before changing the actions. To succeed in the transition towards CE, efforts on developing organizational culture and the human side are as important as developing new technologies. Although we can find studies that address the relevance of conduct researches in organizational behaviour for CE, this theme remains unexplored and requires more efforts. Thus, the aim of this paper is to propose a theoretical framework that addresses the requirements to be considered for the full transition towards CE from the organizational perspective.

This paper is organized in 5 sections. Section 1 brings the introduction and contextualization; section 2 shows the theoretical background. Section 3 presents the methodological procedure. Section 4 presents the detailed results and discussion. Section 5 presents the conclusions.

2. Theoretical Background

2.1.Circular Economy

CE is a multidisciplinary field that brings together different approaches, methods and tools aiming at promoting a change to a more sustainable society (Parida et al., 2019). It is considered an umbrella concept (Blomsma & Brennan, 2017) based on a fragmented collection of ideas derived from a variety of disciplines and schools of thought (Korhonen, Honkasalo, et al., 2018), such as industrial ecology, cradle-to-cradle, biomimicry, performance economy, natural capitalism and others (EMF, 2012). CE is an alternative for the unsustainable linear economy, since it decouples economic growth from resources consumption (EMF, 2014; Geissdoerfer, Savaget, Bocken, & Hultink, 2017). CE has different definitions as can be seen in the study of Kirchherr, Reike, & Hekkert (2017).

Homrich, Galvão, Abadia, & Carvalho (2018) say that “CE is a strategy that emerges to oppose the traditional open-ended system, aiming to face the challenge of resource scarcity and waste disposal in a win-win approach with economic and value perspective”. The most known definition of CE says that CE is an industrial system that is restorative or regenerative by intention and design (EMF, 2012), it is an economy that provides multiple value-creation

mechanisms which are decoupled from the consumption of finite resources (EMF, 2014). Despite the number of CE definitions in literature and the similarities among them, there is no consensus about a single common definition that should be used as the basis for the transition towards CE. Thus, we understand CE as a sustainable strategy performed by a variety of stakeholders inserted in the business ecosystem aiming to leverage the systemic effectiveness through dematerialization of products and sharing.

The most common innovations towards CE implementation are the innovations in business models whose result in the Circular Business Models (CBM). CBM can be considered as a strategy to foster sustainable development (Geissdoerfer et al., 2017). CBM is "the rationale of how an organization creates, delivers, and captures value with slowing, closing, or narrowing flows of the resources loops" (Oghazi & Mostaghel, 2018, p. 3). Implementing CBM requires radical changes in organization and requires collaboration, communication, and coordination within complex networks of interdependent but independent stakeholders (Antikainen & Valkokari, 2016). The most disruptive CBM is the product-as-a-service (PaaS), considered as an approach to enhance the sustainability performance due to its potential to improve resource efficiency by extending the product lifetime and decoupling value from the delivery of physical products (Kjaer et al., 2018). Implementing CBM in order to achieve circularity and sustainability requires openness to change and acceptance of failure as a way to learn and improve performance. Moreover, new skills and capabilities should be developed to support a new culture focused on circular characteristics and the relationships performed in the ecosystem (Smith, 2006).

2.2.Change Management & Organizational Culture

Change Management is a theory mostly used to develop organizational competences and capabilities to deliver results. It focuses on plan how change programs are conducted considering aspects of organizational culture, leadership, strategy, organizational learning and organizational alignment (PROSCI, 2018). It incorporates organizational tools that can be used to help individuals transition successfully in adopting and realizing change (Kotter, 1995). According to Christensen & Overdorf (2000) there are three factors that should be evaluated before starting a change project: resources, processes and values. Resources are tangible, like equipment, technology and assets; and intangible such as information, brand and relationships. Processes are established by the pattern in which the employees do the activities repeatedly. Values are the patterns that allow the employees to make decisions. These factors influence the

changes that an organization could or could not realize. With time, the processes and values are incorporated in the organizational culture, which result in long-lasting and successful changes.

The concept of organizational culture emerged in the 1980s (Hofstede, 1981; Pettigrew, 1979) and since then became one of the most influential concepts in the management research and practice (Linnenluecke & Griffiths, 2010). One frequently cited definition from organizational culture is Schein (1984, p. 3) "organizational culture is the pattern of basic assumptions that a given group has invented, discovered, or developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid, and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems". Hofstede (1981) says that the organizational culture is the collective programming of the mind that distinguishes members of one organization from another, although, the culture is understood as valid for those who share the same context, including all the stakeholders which are part of the system.

The organizational culture reflects a sense of identity between the employees, promotes unwritten and unspoken guidance about how to succeed in the organization, and it highlights the social system stability (Cameron & Quinn, 2011). Organizational Culture is based on values relatively enduring, embodied in organizational norms, rules, standard procedures, and organizational goals (Jones, 2013). According to Schein (1984) the organizational culture is composed by three levels: artefacts & creations (policies, processes, objectives, organization structure etc., this is a visible but often not decipherable level); values (the values declared and open to debate); and basic assumptions (the 'grounded' values not open to debate, taken for granted, invisible and preconscious, related to the relationship to environment, nature of reality, and nature of human relationships).

Culture is high associated with organizational outcomes and is a root metaphor that conceptualize what an organization is rather than what it has (Smircich, 1983). It has fundamental role in hinder or foster innovations, as affirmed by (Schein, 1984, p. 3) "organizational culture is the key to organizational excellence". However, frequently organizational culture is not considered as an important factor to foster organizational changes and transformations. Schein (1996) affirms that we fail to comprehend that culture is the most

powerful force operating in organizations to maintain the system stability. The relevance of organizational culture in increase performance is usually ignored because it embraces complex factors such as values taken for granted, underlying assumptions, expectations, collective memories and other factors present in an organization (Cameron & Quinn, 2011).

The Results Pyramid describes how three essential components of organizational culture – experiences, beliefs, and actions – work in harmony to achieve results (Connors & Smith, 2011). Experiences foster beliefs, beliefs influence actions, and actions produce results. Thus, to get different results, a new culture should emerge, or at least, the current culture should be transformed. Thus, Organizational Culture is often the primary reason for failure in implementing organizational changes (Linnenluecke & Griffiths, 2010). This usually occurs because organizations focus all their efforts in change tools, techniques and strategies, and forget to change the fundamental values and beliefs to support the implemented changes (Cameron & Quinn, 2011). Embracing CE and sustainability can be viewed as the result of both organizational culture and strategic management decisions. Circularity orientation occurs when an organization already has an innovative, outward-looking culture (Linnenluecke & Griffiths, 2010), consciously integrates sustainability goals into strategies, reinforces and rewards employees, and demonstrates the connection to firm performance (Galpin, Whitttington, & Bell, 2015), characterizing a Green Organizational Culture.

2.3.Green Organizational Culture

Green organizational culture is an environmental ideology promoting economic, social and ecological development (Gürlek & Tuna, 2018). It involves a new perspective for organizations which are concerned with environmental management for the benefit of the environment as an economic alternative for organizational operations (García-Machado & Martínez-Ávila, 2019). Green culture has dual characteristics that are internally integration of shared vision, and external adaptation to the changes in policy and market (Yang, Sun, Zhang, & Wang, 2017). The incorporation of environmental concerns into the organizational culture may deliver environmental capabilities that competitors would find hard to imitate (Russo & Fouts, 1997). An organizational culture focused on sustainability is an organization where members have common beliefs about the importance of balancing economic efficiency, social equity and environmental responsibility that guide managers and employees in decision-making process (Paraschiv, Nemoianu, Lang, & Szabó, 2012).

An organizational culture focused on environmental issues is influenced by many forces and interests, internally and externally, requiring management and leadership to continuously stay

open-minded (Ates & Bititci, 2011). Organizations that possess an organizational culture in which employees are encouraged to promote circular and sustainable practices could achieve a competitive advantage in accordance with the view of the company based on a systemic view. Although there are studies and definitions of green organizational culture, they do not address the particularities of CE, thus, being necessary to develop a culture that incorporates the characteristics of CE.

3. Methods

Systematic literature review was chosen striving for an overview of the scientific development of CE transition from an organizational perspective, focusing on previously published studies. An integrative and multidisciplinary literature review was applied, since this research aims to address two types of topics: mature and new (Torraco, 2005). According to Torraco (2005) literature review of a mature topic addresses the need for a review, critique, and the potential reconceptualization of the expanding and more diversified knowledge base of the topic as it continues to develop, while literature review of new/emerging topics would benefit from a holistic conceptualization and an initial conceptualization (e.g. new model or framework).

This article assumes there are still gaps in CE literature about its transition considering an organizational perspective, which included organizational culture and change management aspects. To deal with this research gap, this study addresses the following questions:

i. What is the scientific state of the art for the integration[6] of CE and Organizational Culture in companies?

ii. What requirements and propositions can be prepared in terms of scientific concepts to guide the development of a theoretical framework?

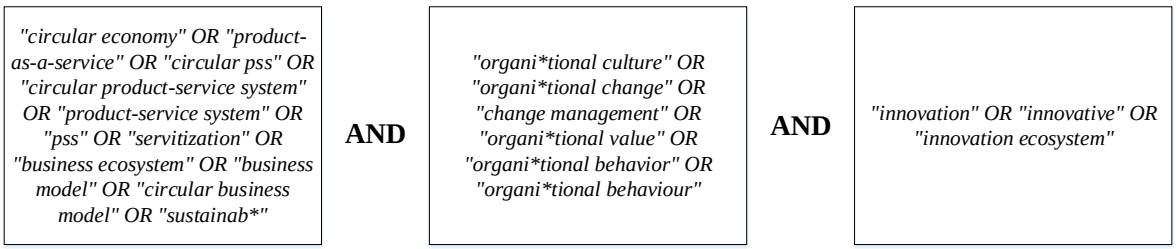
The systematic review procedure adopted is shown in Table 1, following the guidelines proposed by (Tranfield, Denyer, Marcos, & Burr, 2004; vom Brocke, Simons, Niehaves, Niehaves, & Reimer, 2009).

[6] By integration we want to say that we searched for studies that directly or indirectly addressed the organizational perspective to implement CE.

Table 1: Systematic Review Steps

Steps	Application in this research
Scope	Both practical and theoretical studies explore the literature regarding the CE transitions from the Organizational Behaviour perspective, and identify gaps in the literature.
Conceptualization	Looks at the literature on what is known about the CE processes of transition considering aspects of change management and organizational culture.
Search	The search was conducted until December 2020 and has no limitation year. Databases used were: Scopus and Web of Science[7] which present a wide content regarding the research topics. Only articles with English spelling were included. We included in our search article, review and conference papers. These keywords were searched in title, abstract and keywords.
Analysis and Synthesis	Publications found were coded and analysed through qualitative data analysis software (NVivo[8]).
Framework	A theoretical framework and a list of requirements for achieving CE from the organizational perspective were proposed.
Research Agenda	Research gaps and opportunities for future research were defined.

The string used to conduct the search in the databases includes three sets of keywords from different areas that when combined could result in important insights for the development of the framework. Representing CE field, we chose "circular economy", "product-as-a-service" and its variations due to the fact that this is the most powerful kind of business model to implement CE, "business model" and "business ecosystem" because these are topics strongly approached by the CE transition; and "sustainability" and its variations because CE is considered as a path to achieve sustainability. Second, keywords related to the organizational side were included in order to identify the role of these concepts in the transition towards CE. Third, keywords related to innovation were included since CE transition through the implementation of circular business models is considered a type of innovation. Both American and British spellings were included in order to not exclude relevant publications from the analysis.



[7] Some categories of both databases were excluded during the search for publications because they weren't in the thematic scope of our research. See Appendix for more information.

[8] It was the 10th version of the Nvivo. The software was developed to assist researchers and others who work with unstructured material to compile, compare and decipher information quickly and safely.

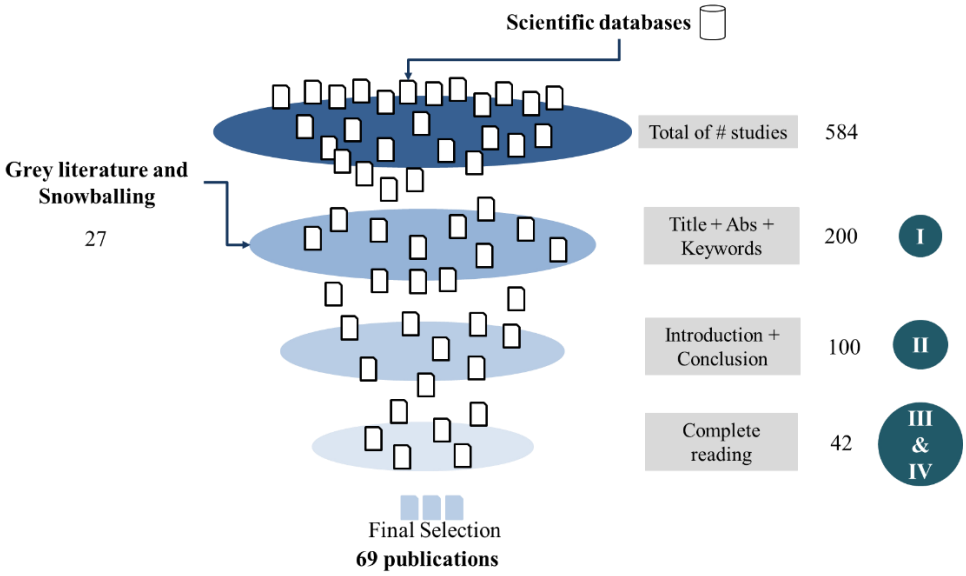
In total, we got a sample of 584 publications (excluding the duplicated papers) for analysis. Inclusion (I) and Exclusion (E) criteria were defined to evaluate the studies, see Table 2.

Table 2: Inclusion and Exclusion Criteria

Inclusion	Exclusion
Present models or frameworks that clearly addressed the integration between CE (and related concepts determine previously) with organizational aspects	Very specific models, frameworks or discussions applied just for certain sector or literature area
Present deep concepts and studies regarding the topics addressed by this paper	Superficial approach of the concepts used in this study

The selection and analysis of publications followed the procedure proposed by (Torraco, 2005; Tranfield et al., 2004) (see Figure 1): (i) title and abstract reading; (ii) introduction and conclusion reading, (iii) full paper reading; and the (iv) evaluation of methodological rigor and contributions of the sample of papers read in the step (iii). Moreover, grey literature[9] and snowballing[10] were also considered for the addition of relevant studies in analysis.

Figure 1: Procedure for selection and analysis of the publications



[9] Studies produced by organizations outside of the academic publishers. It includes reports, working papers, government documents, and white papers and evaluations.
[10] Selection of other studies identified through the reading of the initial sample of studies.

This study focuses on analysing the literature on the subject of CE transition from the perspective of organizational aspects. Due to the scope of the subject, meta-analysis and content analysis were chosen to help the review. Moreover, such review entails several challenges regarding dispersed literature and systemic aspects.

Dispersed literature: there are still few publications on CE specifically addressing the soft and organizational side. Yet, there is a lot of scientific work on the technical side of CE. There are also a plenty of publications dedicated to organizational behaviour and organizational change.

Systemic aspects: according to the introduction, this study follows a proposal directed to a systemic approach to CE transition, with the business ecosystem perspective. That means, we studied micro transformations in organizations (organizational culture) aiming to contribute for the macro transformation in systems. Therefore, the search for information exceeds the boundaries of the product/services, processes and business models, including business ecosystem and the sociotechnical view.

With the selected papers, a content analysis was performed in a two steps plan: (i) review of the model's approaching CE or sustainability combined with CM or OC; and (ii) theoretical framework construction. According to Duriau, Reger, & Pfarrer (2007) the content analysis is used to understand the deeper meaning embodied in a text. We used the software NVivo in order to support the publications analysis and to identify relations between the publications. An integrated critical synthesis and analysis of the publications identified were performed and are presented in the section 4.1. Moreover, in section 4.1 we present the state of the art through the classification of the analysed publications regarding the main topics and concepts that each paper discussed, and by the style presentation of the results and the methodological approach. Finally, a theoretical framework presenting the ideal future state of a CE-oriented organizational culture was proposed based on the critical literature analysis.

4. Results & Discussion

4.1.Change Management and Organizational Culture into the CE literature

The 69 publications were analysed regarding their methodological approach, the style presentation of the results, the factors related to organizational culture, the research focus or research object, and major contributions (see Table 1 in Appendix). The majority of the publications were not focused on the soft side of CE, but they present good contributions in associated topics such as sustainability, eco-innovation, eco-design; being an inspiration to propose and develop our theoretical framework.

Table 3 explores the distribution of the publications along the different theories covered by the analysed studies. The columns present the theories related to organizational management and the lines the theories related to the business trends. The red lines show the different quadrants that we observed regarding the combination of theories. As can be seen, the majority of the studies are in the first quadrant. This occurred due to the combination of keywords used. This quadrant is very relevant for this research since we tried to gather knowledge from the combination of those theories to propose our theoretical framework. The intersection between Organizational Culture and Green Theories were the theories combined in the majority of the studies (11 publications); followed by studies combining Organizational Culture and Sustainability (10 publications), and Change Management and Sustainability (8 publications). The second quadrant contains the studies that use broader and systemic theories to explain the implementation and development of the green theories. There are a quite expressive amount of studies in literature combining these theories; however, they are out of our research scope since the combinations keywords used do not represent entirely the literature in these topics. The relevance of those studies for us is to understand this broad and systemic view for the transition towards CE (Francis, Bessant, & Hobday, 2003a; Lewrick & Raeside, 2010).

The third quadrant presents the combination of more generic theories that can or cannot be applied to CE (business model innovation, organizational transformation, digitalization and industry 4.0) with organizational culture, change management and people & behaviour. Some of the studies approach concepts of Industry 4.0 and Digitalization combined with organizational culture (Isensee et al., 2020; Sansabas-Villalpando, Pérez-Olguín, Pérez-Domínguez, Rodríguez-Picón, & Mendez-González, 2019) and since these concepts are emergent and disruptive as CE, it is important to understand how the authors are incorporating organizational change theory in the implementation of such concepts. And the fourth quadrant presents the combination of more generic theories that can or cannot be applied to CE (business model innovation, organizational transformation, digitalization and industry 4.0) with the broader theories of transition management, organizational transformation and ecosystem. Both quadrants have an expressive number of studies available in literature, however, not in the very specific context of our study. Thus there are also out of our scope but the analysed studies in those quadrants gave us a lot of relevant insights for the proposition of our theoretical

framework. The important is to observe that only few studies are dedicated to understanding the soft side of CE. Moreover, the majority of approaches address only discussions and impacts of organizational culture in CE implementation showing a huge opportunity to increase the research in this area.

Table 3:Theories presented in the analysed publications[11]

Org. Management / Business Trends	Organizational Culture	Change Management	People & Behaviour	Transition Management	Organizational Transformation	Ecosystem
Sustainability	10	8	4	3	0	0
Green Theories (ex: ecodesign, ecoinnovation)	11	2	3	2	0	0
Servitization/PSS	4	6	4	2	0	0
CE	5	4	3	1	0	1
Sustainability & CE	3	3	4	0	1	0
Business Model Innovation	3	2	1	0	0	0
Organizational Transformation	0	0	0	0	2	0
Digitalization	1	0	0	0	0	0
Industry 4.0	0	1	0	0	0	0

We also analysed the methodological approach used in the studies (see Figure 2a). 50 of the 69 publications use a qualitative approach to collect data, frequently based on literature reviews, case studies and interviews (e.g. (Afshar Jahanshahi, Brem, & Bhattacharjee, 2017; Hock, Clauss, & Schulz, 2016). This might be related to the novelty of the field which requires deeper literature and practice investigations.

In terms of style presentation (see Figure 2b), the majority of the studies bring the results in the format of a theoretical framework (49 from the 69 publications), followed by manual/guideline/tool (16) and process model (4). In terms of theoretical frameworks, the most common styles of representation are classifications, categorizations, and organization of data by similarities (Hock et al., 2016; Ziaee Bigdeli, Baines, Bustinza, & Guang Shi, 2017; Zollo et al., 2013). In manual/guideline/tool the focus was on visualization or steps to direct changes. Concerning the process models the focus is in explain steps for the transition or implementation process.

[11] The sum of papers in this table could be more than 69 because there are some papers that studied more than one theme, as can be seen in table 3 in the Appendix.

Figure 2a - Methodological Approaches

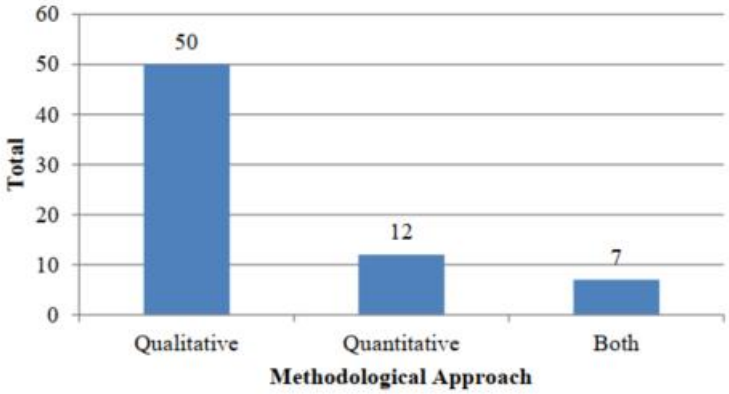
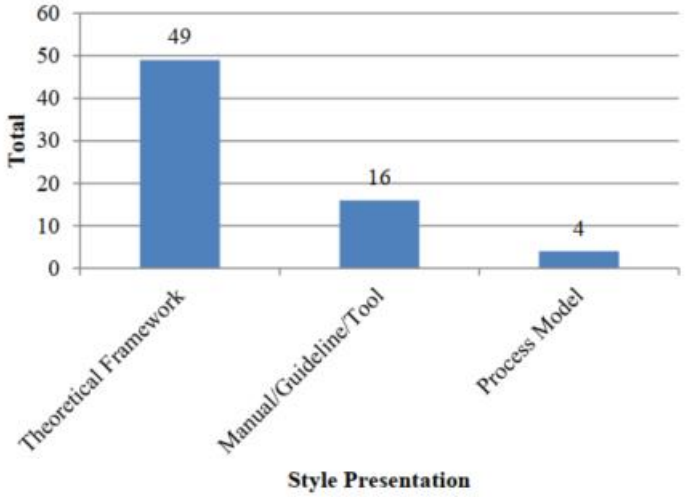


Figure 2b - Style Presentation of Results



In synthesis, we observed that the transition towards CE is triggered by certain factors or events in organizational environment or within the system itself (Geels, 2002; Savaget, Geissdoerfer, Kharrazi, & Evans, 2019). Some studies focused on the ecosystem perspective, highlighted that stakeholder, inside and outside the organization, tend to be involved in the CE transition (Konietzko, Bocken, & Hultink, 2019; Parida et al., 2019). Additionally, the organizational perspective highlights the role of organizational culture, leaders and other organizational members in CE transition (Davis & Boulet, 2016; Liu & Bai, 2014), aspects that are often overlooked. Previous literature showed us that technical aspects, such as product, process and business model innovation, and technology development are hot topics in CE research

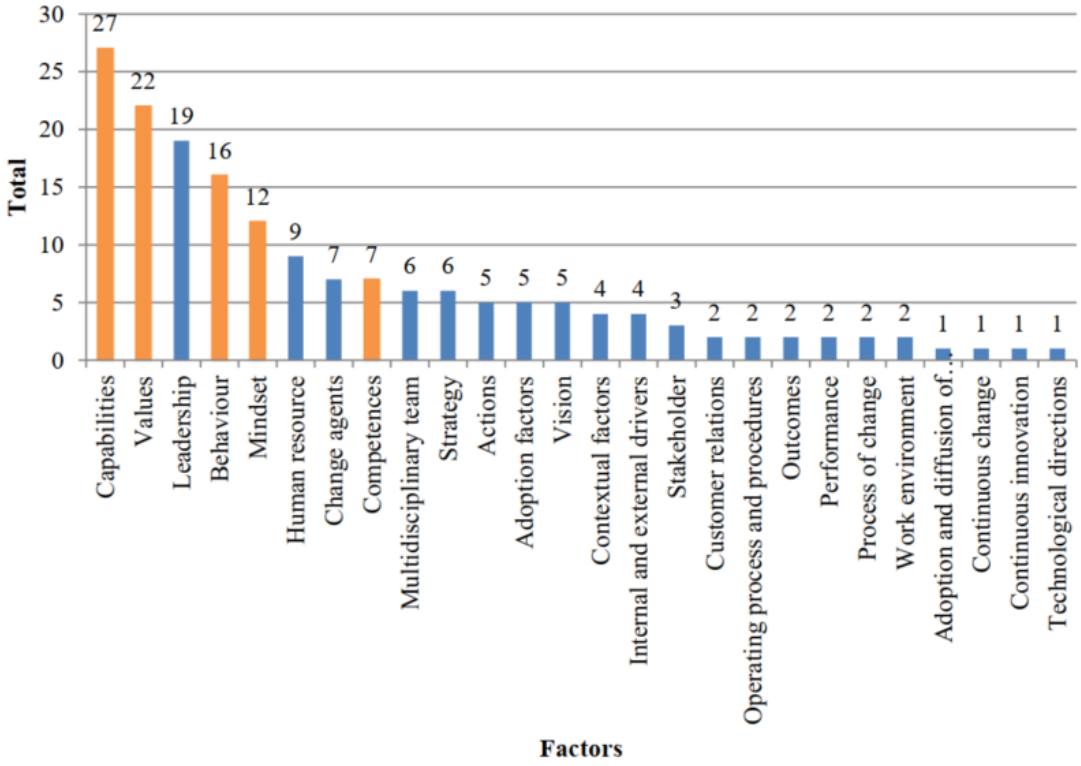
(Guldman & Huulgaard, 2020; Linder & Williander, 2017; Mestre & Cooper, 2017). Moreover, some authors say that a model to guide a transformation path should be cyclical, based on continuous improvement, and should include organizational culture and change capabilities (Dewberry & de Barros, 2009; Wiesner, Chadee, & Best, 2018). However, the publications regarding the soft side of CE are still few and shallow, focusing mostly on customer's behaviour (Ketprapakorn & Kantabutra, 2019) or human-resources (Chiappetta Jabbour et al., 2019) forgetting the essential role of organizational culture in this transition journey.

Leading the journey of building and sustaining a CE-oriented culture is particularly difficult and challenging for three reasons. First, because a CE-oriented culture requires a combination of behaviours that can be risky for organization in the short-term thus creating a certain confusion regarding the change. Second, the leader can face some employees that are resistant to change towards the CE. Third, because a circular culture is a system of interdependent behaviours, inside and outside the organization, it cannot be implemented without considering the whole system. It is necessary to understand how organizational issues complement and reinforce one another to create a CE-oriented culture.

We gathered from the analysed publications some factors that the authors presented as important for the proposition and/or maintenance of a culture oriented to environmental aspects[12]. We observed that these factors, presented in Figure 3[13], represent different aspects of the organization. They include: the people and human factor, values, mindsets, the drivers and contextual events that triggers the changes, aspects regarding manage changes and innovations, behaviours, the stakeholders and customer role, the need for the organization to get results and performance, aspects of learning and knowledge acquisition, capabilities, internal processes and procedures, strategic orientation, values, mindsets, and competences. The orange bars in the graph were chosen to compose the five building blocks of our theoretical framework. They were chosen based on the amount of authors that cited it and following qualitative aspects about the meaning of each factor. We understand that the factors that are not considered as a building block is implicit represented and comprised by the defined building blocks.

[12] See column "factors" in Table 1 in Appendix for more details.
[13] We developed this figure based in the information provided in Table 2 in the Appendix.

Figure 3: Relevant factors for the proposition of a CE-oriented culture



It is consensus among some organizational culture authors that the culture is rooted in values, beliefs and assumptions shared by organizational members (Alm & Jönsson, 2014; Cameron & Quinn, 2011; Schein, 1984). These characteristics influence the behaviour of employees towards new management systems and, these new management systems influence organizational performance outcomes. Moreover, these new management systems are implemented through the acquisition of new capabilities and the development of competences. The five building blocks that compose a CE-oriented culture are described in the section below, as well, as their roles in the theoretical framework.

4.2.Theoretical Framework - The five Building Blocks for a CE-oriented Culture Change

Organizations should consider three facets to deal with any kind of change: why change, what change and how change. For CE transition there are some aspects that explain why organizations should change towards CE such as economy, technology, regulations, society and environment. There are some aspects that should be changed such as products and services,

business models, organizational structures, business ecosystems and organizational culture. There are some approaches that could help in the conduction of the change, such as readiness assessment tools, support systems, maturity models and roadmaps. In this study, we link insights of hard and soft factors of CE transition considering both organizational and ecosystem perspectives. We are aware that we cannot fully and deeply address all of the facets of change in our study, thus our framework takes into account all the factors that affect the micro and macro environment for the transition towards CE but focus specifically on organizational culture to support the organizational evolution towards the CE.

Our theoretical framework is composed for five building blocks: mindsets, values, behaviours, capabilities and competences. Below we describe each one of them.

(i) Values

According to Jones (2013) values are criteria, patterns or directional principles that people use to determine what types of behaviours, events and results are desirable or undesirable. Values define what an organization should or should not do; additionally, these values reflect the structure of costs or business model, since these points define the rules that the employees should obey for the organization to flourish (Christensen & Overdorf, 2000). Values are a critical aspect for a CE-oriented culture; since they transmit the things the organizations believe are most important (Bernon, Tjahjono, & Ripanti, 2018). Usually, we have some awareness of our own values, but they are largely invisible to others. In this research, CE-oriented values are defined as an attribute and a facilitator that determines the mindsets and behaviours needed for the transition towards a CE.

CE-oriented values are related to the future state of a circular organization, e.g. essential for the support of a CE-oriented culture. The organizational values hold the organizational structure and identity (Ashforth & Mael, 1989), the organizational strategy (Bansal, 2003) and are the basis and least visible element of the Organizational Culture (Schein, 1984). Organizational changes towards CE require values modification and alignment with the CE principles and strategies.

(ii) Mindsets

According to Dweck (2012, p. 625) mindsets are “people’s lay beliefs about the nature of human attributes […] some people hold a fixed mindsets and believe that human attributes are simply fixed traits while other people hold a growth mindsets and believe that their qualities can be developed through nurture and their own persistent efforts”. Mindsets are the underlying

philosophy and attitude. Extending the Dweck's definition of mindsets for the organizational level, growth mindsets encourage curiosity and risky-taking attitudes while fixed mindsets focuses on continuing through the traditional and known path.

Mindsets are the assumptions, in this way a CE-oriented mindsets is considered as the beliefs or mental attitude aligned with the CE principles and circular values that determine how the organization will interpret and respond to situations.

(iii) Behaviours

Muranko et al. (2018) coined the term pro-circular behaviour, defined as "an action which is brought about due to prioritizing resource-efficiency". For Liu & Bai (2014) environmental behaviour of a firm is influenced for internal factors and contextual environment, such as governmental regulations, markets and neighbourhood residents, and should be economically beneficial, environmentally benign and socially responsible (Joshi & Seay, 2019).

Circular behaviours describe how people and organizations act in the cause of CE transition. For leaders, this means energizing employees with a vivid vision of how the organization should look like in a circular state. For employees, actions that support the CE transition include the acquirement of new competences. Behaviour is not immutable (Maitre-Ekern & Dalhammar, 2019) and can be changed and evolved to a CE perspective.

According to Singh, Chakraborty, & Roy (2018) a behavioural intention is presented in people who are determined by three factors: attitude, subjective norms and perceived behavioural control. Attitude is the mental and neural state of organizations' leaders/managers which influences the implementation of CE (B. Kumar, 2012; Montalvo, 2003). Subjective norm is the perception about undertaking or not a specific behaviour by an organization influenced by stakeholders pressure (Singh et al., 2018). Perceived Behavioural Control is related to the capabilities and management beliefs of the firms to execute CE readiness (Montalvo, 2003).

(iv) Capabilities

PMI (2017) defines capability as "the ability to add value or achieve objectives in an organization through a function, process, service, or other proficiency". Teece (2014) defined capability as the ability to do something and is constituted by both strategies and operational

activities. Teece (2000, 2010) brought up the idea of dynamic capabilities defined as the ability to reconfigure, redirect, transform, appropriately shape and integrate existing core competencies, aided by external resources, strategies and complementary assets to meet the challenge of a time-pressured, rapidly changing world of competition and imitation. With other terms, Winter (2000) presents the operational capability as a high level of routine (or collection of routines) that, together with its implementing input flows, confers upon an organization's management a set of decision options for producing significant outputs of a particular type. In the same sense, Teece, (2014) proposes the term ordinary capabilities, which involve the performance of administrative, operational, and governance related functions that are (technically) necessary to accomplish tasks. Additionally, Teece (2017, p. 4) presents industrial capabilities as those "able to continuously sense and seize opportunities, and to periodically transform aspects of the organization and culture so as to be able to proactively reposition to address yet newer threats and opportunities as they arise".

CE-oriented capabilities is the ability to reconfigure, redirect, transform, shape and integrate existing core competences with external resources, circular strategies and complementary assets to meet the challenges of the CE transition journey. They capture the CE-specific competences an organization requires as part of its transformation effort. Moreover, they reflect the new capabilities organizations need to develop or acquire to design circular business models and systems.

The capabilities are acquired through the development, learning, and exchange of knowledge (Prieto-Sandoval, Jaca, Santos, Baumgartner, & Ormazabal, 2019) which are transformed into competences to delivery competitive advantage.

(v) Competences

Mirabile (1997, p. 75) define competence as a "knowledge, skill, ability, or characteristic associated with high performance on a job, such as problem solving, analytical thinking, or leadership. Some definitions of competence include motives, beliefs and values". For Hamel & Prahalad (1996, p. 279) "competencies are the collective learning in the organizations, especially how to coordinate diverse production skills, integrate multiple streams of technologies […] organize the work and deliver value".

Competences are the most developed and experienced capabilities that become the sources of competitive advantage (Zott, 2003). Thus, competences are the organizations' differential. They are difficult to imitate in the marketplace and have strategic value which implies a need

to update them continually (Teece, 2014). Competences are underlying attributes that enable difficult things to be done reliably and economically, they can be dynamic, and once an organization possesses a competence it can do things that had not been considered previously (Francis, Bessant, & Hobday, 2003b).

CE-oriented competences are understood as a set of combined knowledge, skills, and attitudes that enable the achievement of successful task performance and problem solving in accordance with the CE principles. In particular, the circular competences show how well an organization is regarded as being circular by its customers, competitors and other stakeholders, and whether circularity has paid off financially.

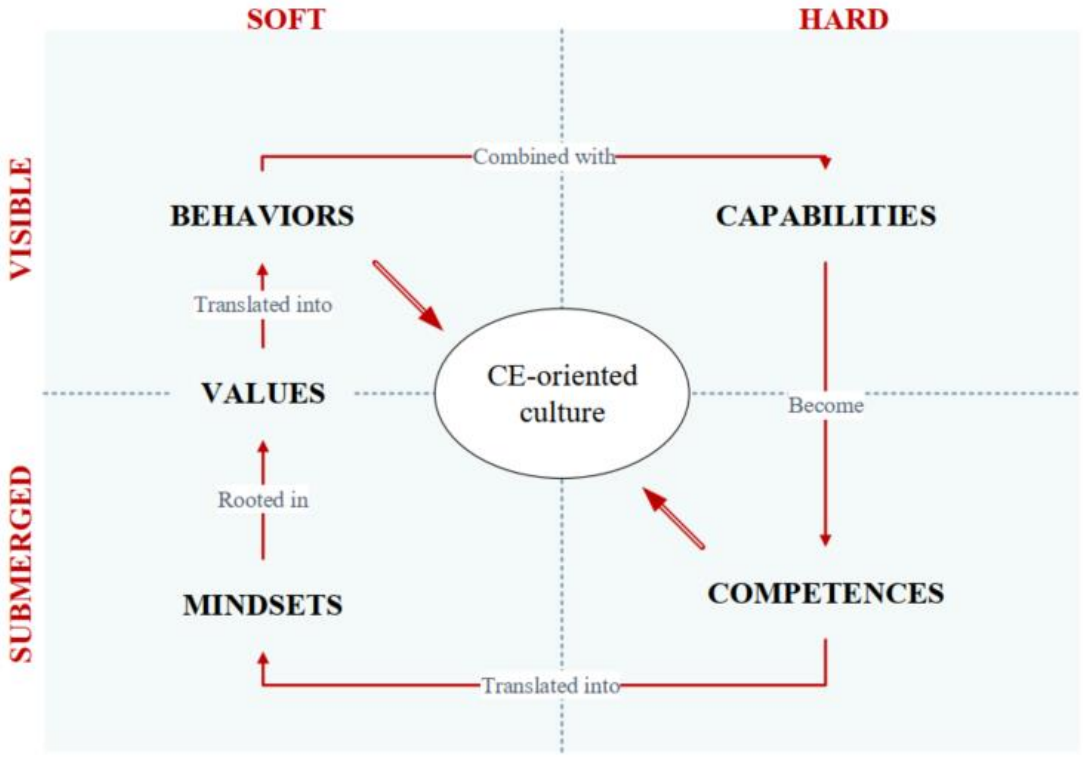
The building blocks are dynamically linked in a 2x2 matrix as show Figure 4. The matrix divides the soft (mindsets, values and behaviours) and the hard (capabilities and competences) building blocks in the columns; and the visible (values, behaviours and capabilities) and the submerged (mindsets and competences) ones in the lines. The soft building blocks represent the aspects that shape the organizational identity and behavioural characteristics. They are aspects related to the collective human behaviour inside the organization. The hard building blocks represent the technical aspects that comprise the organization, such as the infrastructure, shared knowledge, technologies and ability to implement strategies. On the other hand, the visible building blocks are the ones that we can observe, map and change, that means, they are liable for intervention when changes are needed. The submerged building blocks, sometimes can be observed or perceived, but is more difficult to make interventions of change on them.

Each building block influences the other. Mindsets are rooted in values. Values are translated into daily behaviours. Behaviours are executed when combined with the right capabilities, that means when combined with the right theoretical knowledge (qualification) and ability (know how to do). Capabilities become competences when they are implemented repeatedly and when they are supported by the attitudes (combination of value, mindsets and behaviours – know how to behave).

When the outcome generated by this cycle is good enough, all the building blocks are reinforced as a form of action that will lead to reaching a CE-oriented culture and sustainable development in the long term. Moreover, when organization play well in this cycle they create conditions to

implement some SDGs (Sustainable Development Goals) that are directly linked with CE: 6-clean water and sanitation, 7-affordable and clean energy, 8- decent work and economic growth, 9-industry, innovation and infrastructure, 10-reduce inequalities, 11-sustainable cities and communities, 12-responsible consumption and production, and 13-climate action (Dantas et al., 2021; Rodriguez-Anton, Rubio-Andrada, Celemín-Pedroche, & Alonso-Almeida, 2019). On the other side, when the outcomes are poor, alerts are triggered inside the organization which enables changes in values, behaviours and capabilities.

Figure 4: Theoretical Framework – the five building blocks for a CE-oriented culture change



This theoretical framework is suitable for practical applications since it brings soft aspects that are essential to support the implementation and proposition of changes in the hard aspects. Leaders can use this framework to understand the circular mindsets that are rooted in the organizational values, and use this insight to shape desired behaviours towards the CE. To support the behaviours and allow changes in the organization, capabilities and competences should be built (Christensen & Overdorf, 2000). Competences are translated into results to the organization and reinforce the organizations' values, mindsets and behaviours. It is important to highlight that not all capabilities and competences have to be built internally; ecosystem partners can support the organization.

A set of actions need to be performed for the development of each one of the building blocks in order to achieve a radical transformation towards a CE-oriented culture. Thus, the next section presents a few of these actions.

4.3.Implementing a CE-oriented culture

In order to develop each one of these building blocks towards a CE-oriented culture, first organizations should recognize the need to change that means: identify internal and external drivers focused on why the organization should move towards CE since enablers allow organization to understand what changes are needed and how they will take place (Almeida & Melo, 2017; Sroufe, 2017). Then, it is important to diagnosis the "as is" situation through a shared assessment of problems and opportunities (Ates & Bititci, 2011) to know how far the organization is to reach a CE-oriented culture and prioritize changes (Bertassini, Zanon, Azarias, Gerolamo, & Ometto, 2021; Walker, 2017). It is also meaningful to understand the strategic directions and business plan towards CE; the technological trends; the CE-oriented management actions; and the consequences of adoptions and diffusion of innovations and changes towards CE in the meso and macro levels (Almeida & Melo, 2017). Values, mindsets and behaviours that refer to collaboration over individuality, sharing/leasing over owner, long-term over short-term should be cultivated (Bernon et al., 2018; Burger, Stavropoulos, Ramkumar, Dufourmont, & van Oort, 2019) in order to nurture an environmental open for the CE implementation.

The development of new culture towards CE requires highly managerial commitment in order to enable managers to spread circular competences and capabilities to the whole organization (Centobelli, Cerchione, Chiaroni, Del Vecchio, & Urbinati, 2020; Moktadir et al., 2020; Sharma, Govindan, Lai, Chen, & Kumar, 2020). Thus, in order to implement a fully CE-oriented culture a Leadership agenda is proposed. Following it, leaders need to:

- Define and/or update a clear and unified vision towards the CE to foster the commitment of employees (Ates & Bititci, 2011; F. A. Brones, Carvalho, & Zancul, 2017; Rizzi, Annunziata, & Frey, 2018).

- Align strategies with culture to enable the full integration of CE goals (Ahuja et al., 2019).
- Integrate stakeholder perspective within CE goals (Obal, Morgan, & Joseph, 2020).
- Develop and formalize an implementation strategy and action plan for progressing toward a higher integration of CE strategies and practices within the organizational culture (Ates & Bititci, 2011; F. Brones, Zancul, & Carvalho, 2020; Long, Looijen, & Blok, 2018).
- Demonstrate the application of appropriate CE by adopting strategies and practices at the operational level to meet current company objectives and stakeholders requirements (Metz, Ilieș, & Nistor, 2020).
- Monitor the execution of the established action plan; and evaluate the coherence of results, progress and gaps (Ates & Bititci, 2011; F. Brones et al., 2020).
- Create and/or adapt performance indicators for the circular context of the organization (Ates & Bititci, 2011; Rossi et al., 2020).
- Adapt and experiment CE tools and practices to company culture (F. Brones et al., 2020).
- Plan for short-term wins and seize on quick-wins early in the change process (Ates & Bititci, 2011; Hatak, Floh, & Zauner, 2015).
- Plan changes that are top to bottom, to create the necessary structure and to provide circular vision and bottom-up, to encourage participation by all employees (Paraschiv et al., 2012).
- Enforcing an organizational identity that prioritizes customers' value creation; customize products/services based on deep customer knowledge (Tronvoll, Sklyar, Sörhammar, & Kowalkowski, 2020).
- Nurture mutual trust and respect (Ahuja et al., 2019).
- Design communication channels to emphasize the core values among employees (Ates & Bititci, 2011; Hatak et al., 2015; Ketprapakorn & Kantabutra, 2019).
- Use the core values as criteria to recruit new employees and avoid laying off employees to preserve the core values (Ketprapakorn & Kantabutra, 2019).

- Create formal procedures, roles and regulations within the organization that are aligned with the CE goals (Rizzi et al., 2018).
- Recombine existing routines in order to cope with the CE vision and goals (Latilla, Frattini, Franzo, & Chiesa, 2020).
- Create a working environment that stimulates economic, social and environmental performance (Metz et al., 2020).
- Develop capabilities and competences with a systemic vision of all the ecosystem partners (Parida et al., 2019; Tronvoll et al., 2020).
- Develop cross-organizational competences (EMF, 2019).
- Build networks and collaborative practices for learning and action around the CE vision (Long et al., 2018; Roome & Louche, 2016).
- Engage with the entire organization as well as multiple external stakeholders in order to balance multiple goals that are sometimes in conflict (Obal et al., 2020).
- Establish external partnership for specialized competences (Tronvoll et al., 2020) and outsourcing non-core capabilities and focus on core ones (Latilla et al., 2020).
- Create new business units and new internal functions (Latilla et al., 2020).
- Create employees' awareness in CE (Davis & Boulet, 2016; Kirsch & Connell, 2018; V. Kumar, Sezersan, Garza-Reyes, Gonzalez, & AL-Shboul, 2019).
- Develop a trustful environment in order to create employee and stakeholders' engagement, and diffuse knowledge (Rizzi et al., 2018).
- Change employee structure through recruitment of employees with a compatible mindset (Tronvoll et al., 2020).
- Build multidisciplinary teams with knowledge and skills relevant to business model innovation, product design, and CE development (Ahuja et al., 2019; de Sousa Jabbour, Jabbour, Foropon, & Godinho Filho, 2018; V. Kumar et al., 2019; Mendoza, Sharmina, Gallego-Schmid, Heyes, & Azapagic, 2017).

- Establish circular centres to ensure that employees, customers and other stakeholders gain first-hand experience of circularity (Tronvoll et al., 2020).
- Develop and nurture communication between employees (Ahuja et al., 2019).
- Encourage, engage and influence employees for successful execution of the CE vision and goals (Agrawal, Wankhede, Kumar, & Luthra, 2021; Ahuja et al., 2019; F. Brones et al., 2020; Obal et al., 2020).
- Identify change agents and build a coalition to implement the planned changes towards CE implementation (Ates & Bititci, 2011).

Organizations that want to have a CE-oriented culture should be rooted in resilience and be able to anticipate key opportunities, survive, adapt and sustain the business in the face of turbulent change (Ates & Bititci, 2011; Walker, 2017). In addition, organizations with a high level of CE-oriented culture are likely to explore circular strategies and practices related to products, customers, markets and environment, and integrate the acquired circular capabilities and competences with the existing ones to facilitate exploitative and exploratory circular innovations.

The understanding and implementation of a CE-oriented culture is a task in which managers must provide their employees with the values, standards, and principles that govern the organization. The CE-oriented culture must be shared and learned within the organization. A clear understanding of the CE-oriented culture is important to all leaders, as they influence the way in which their organization react to the business change requirements in the transitions towards the CE. In order to create a long-lasting CE-oriented culture, organization should invest in the development of their own leaders.

4.4.Advancing research on CE oriented organizational behaviour

The systematic analysis of the 69 publications enabled the identification of gaps either pointed as limitations by the authors or with the support of the characteristics identified in the analysis. These gaps were translated into future research opportunities to advance research on CE-oriented organizational culture:

- In terms of behaviour, researches are better developed in the change customer behaviour aspects for accepting circular products and business models. In this context, sometimes organizations have a reductionist approach, interpreting the need for mindsets change for CE solely as required for the customer side. Future research

should work for establishing a direction and emphasizing that mindsets changes for CE goes beyond the customer interface;

- The leadership support and guidance, and effective communication inside organization are essential for a successful CE transition, thus more structured and exploratory research on these topic needs to be developed;
- Values (individual, organizational and societal) are important to be in place, in addition to effective tools or methods to map, measure and develop them. Values are catalysers for incorporating CE principles into organizational strategies and orientation, and to change consumer and society behaviour, thus, more effort are needed in this sense;
- The mechanisms for organizational culture configuration towards CE should be developed with a broader view than only looking into individual human-resource development. Thus, it is necessary to consider the collective human-resource development and the awareness of employees to act as a team for CE actions implementation;
- Paths of CE transition and sustainability implementation regarding change management and organizational culture aspects are being developed in parallel and are not fully explored. Future research should explore their appropriate combinations and applicability;
- The CE concepts and applications are being developed with internal lenses in the majority of the studies. To contribute to the required longitudinal transformational perspective, where new visions, values, mindsets and behaviours need to be disseminated and translated into ecosystem level, we encourage researchers to contextualize their contributions in regards to the socio-technical and ecosystem view of CE cultural transition;
- Organizations seek practical and clear guidance to implement actions and strategies at ecosystem level to transition towards a fully CE-oriented culture. Development

of tools that help organizations to overcome the barriers to implement CE and that present how to face the transition journey should be developed;

- Quantitative methods and tools that support strategic decision-making are also essential for CE development. Proposal for quantitative assessment and indicators focused on the soft side of CE could serve as a way to address societal and human development, and serve as a way of establishing concrete targets for business outcomes that should be monitored longitudinally along the CE transition;
- Applying different research methods are also essential for CE-oriented culture literature enrichment. Empirical in-depth studies based on field research are required to move approaches, methods and tools from the experimental and theoretical stage to contribute to their maturation and practical implementation. Cultural changes towards CE lead to real and long-term transformations in organizations requiring the use of longitudinal studies and action research. Action research enables the investigation of the aspects and/or their results of the use and improvement of theoretical frameworks, methods and tools in real-time. Longitudinal research enables the evaluation of long-term consequences and results on the application of the proposed solutions.
- The majority of these analysed studies propose a framework or a manual that provides directions for 'what' is required to be changed, but not necessarily guidance on 'how' to do it. For instance, the manual/guideline/tool and process models are especially important to provide a collaborative and defined way to conduct/implement some change for CE.

5. Conclusions

With this research we aimed to identify and systematize the relations between CE, sustainability and organizational culture available in literature, in order to provide a clear overview on this topic for scholars and practitioners. This study expands the boundaries of research in the CE field by integrating Organizational Culture, Change Management approach for the transition towards the CE. This research has led to combining Organizational Culture with a systemic CE integration to elaborate a promising theoretical framework. This proposition is seen as a new synthesis of diverse sources from the engineering literature and social sciences, building on similarities and complementarities produced on the first twenty years from the XXI century.

This article systematically identified and analysed 69 publications, i.e. theoretical frameworks, methods and tools; that brings the idea of development of an organizational culture focused on green aspects and theories such as sustainability, CE, eco-design and eco innovation. Based on the analysis it was observed that organizational culture aspects are neglected by CE literature. Usually, CE studies consider the relevance and importance of organizational culture for CE transition – i.e. as an enabler or a barrier – although do not study how it can foster CE development. The literature analysis enables to merge some of the best theoretical constructs and practices in a systematic and integrative perspective, as a promising approach towards more effective soft aspects of CE transition integration. Thus, a theoretical framework composed of five building blocks was presented as synthesis of the analyses. Moreover, a number of gaps and future researches to advance the research field were outlined.

This research contains some limitations. Firstly, the keywords and core strategies to categorize the approaches presented in Table 2 are instrumental to our identification and selection of sustainability/CE-oriented organizational culture approaches, which makes the interpretation and analysis dependent on our understanding of CE and organizational culture theory. Another limitation is that the systematic search in academic databases was followed by snowballing and inclusion of non-peer reviewed publications from specialist institutions, which may generate selection bias. Moreover, the focus has been on academic literature with only few contributions from practice. As implied in the challenges of undertaking a literature review on this topic, such as dispersed literature and systemic aspects, the main limitations of this review regard the fact that some studies may not have been identified in the search processes.

As mentioned, gaps identified by this research require future empirical work. This paper documents the first step of a comprehensive research to promoting the development of a cultural roadmap to guide the CE transition journey. Moreover, the findings need to be matched with requirements of practitioners, thus requiring field research and directly interactions with organizations. Despite this, the paper provides contributions for the research community and practitioners.

5.1.Theoretical Implications

The proposed theoretical framework connects CE and organizational culture, concepts that are rarely combined in literature. We have observed that there is a lack of understanding, and guidance on how organizational culture influences the transition and maintenance of a CE system. In this study, we seek to contribute to a better understanding of this process. In particular, we show a theoretical perspective about how organizational culture influences the transition towards the CE.

CE is a sustainable strategy performed by a variety of stakeholders inserted in the business ecosystem aiming to leverage the systemic effectiveness through dematerialization of products and sharing. Thus, decisions about the implementation and success of a CE are influenced by an effectual logic and behaviour: why to change (triggers that foster the change), what to change (aspects of the organization and the system that should be changed to the implementation of the CE), and how to change (tools and methodologies that guide the change). These are the findings from literature that supports the hypothesis that the organizational culture can help in the transitions and maintenance of a circular system. To the best of the authors' knowledge, studies like that were not found in previous literature, thus, this research is a great contribution for the academy.

5.2.Managerial Implications

For practitioners, we provide an overview of existing approaches for a CE-oriented organizational culture. This research has tried to consider the real complexity of business as a living organization, and recognized the importance to be given to soft issues in the transition towards CE. Radical organizational transformation requires multiple and systemic changes, such as: redefinition of strategies, organizational culture realigned around different values, processes re-worked and value chains redesigned. The strategic orientation is very important for the implementation of CE; however, if organizational culture doesn't work the strategy will not work as well. This is confirmed by the common sentence said in the literature business "culture eats strategy from breakfast". The strategy should be aligned with the culture, and if the circular strategies implementation isn't supported by culture, the organization must be dedicated to change its culture and thus, elevate its circularity.

The CE transition efforts may be managed in the organization structure and in its business ecosystem as a whole, encompassing technical changes associated with the products, processes, business models, systems and metrics, as well in the organizational values, behaviours and competencies. CE requires an environment that promotes the adoption of new technologies, encourages organizational learning and develops capabilities to overcome barriers and

resistance to change. Organizations should develop ability to change in order to incorporate CE opportunities, which implies developing multiple and iterative changes.

In an organization with a CE-oriented culture, employees could be more receptive to CE concepts and practices, and more active in innovations towards sustainability. In addition, organizations could be more likely to seriously examine and continuously adapt its culture towards CE and Sustainable Development. The framework fits with the understanding that taking into account only the technical side of CE is not worth it in the long term since people are the key for long-lasting changes. It is therefore important to recognize this, and to make practitioners aware of it, and in turn to develop a more clear and systemic process to integrate the soft side of CE into the transition journey.

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APPENDIX B – PAPER 2

Bertassini, A. C., Ometto, A. R., & Gerolamo, M. C. (2021). The role of Organizational Culture in the Transition towards the Circular Economy – a practical perspective. 4th PLATE Conference.https://researchrepository.ul.ie/articles/conference_contribution/The_role_of_organizational_culture_in_the_transition_towards_the_circular_economy_a_practical_perspective/19867135

The role of Organizational Culture in the transition towards the Circular Economy – a practical perspective

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Keywords: Circular Economy; Organizational Culture; Sustainable Development; Transition Processes.

Abstract: In order to achieve long-lasting changes and institutionalize Circular Economy (CE), current organizational 'business-as-usual' cultures need to be challenged beyond technological or managerial changes. However, we identified that Organizational Culture (OC) is not considered an essential aspect to foster organizational transformations towards the CE. Thus, the aim of this paper is to analyze what role plays the OC concepts in the transition towards the CE. In order to accomplish this goal, we conducted a literature review seeking evidence that corroborates with the affirmation that OC is essential for CE transition. In addition, we conducted 13 semi-structured interviews with people from different areas from a multinational steel company located in Brazil. Our literature review showed us the role that OC plays in the transition towards the CE. We identify that OC is extremely important in supporting long-lasting changes as confirmed by the interviews. We observed that the managers were aware of the impact that the wrong culture could have in the implementation of CE strategies; however, they also affirm that the organization must work harder and develop more organizational actions in order to disseminate a circular culture throughout its entire ecosystem. We concluded that OC has a high impact in the transition journey towards the CE, and that organizations must put efforts in the change and adaptation of their culture towards one that supports CE.

Introduction

CE is a multidisciplinary field that brings together different approaches, methods and tools aiming at promoting changes to a more sustainable society (Barreiro-Gen & Lozano, 2020; Lozano et al., 2021).CE is defined as an "industrial system that is restorative and regenerative by intention and design, replacing the end-of-life concept and the use of toxic materials with the use of renewable energy, and materials that can be reused and returned to the biosphere, and aimed at replacing waste with superior design of materials, products, systems and business models" (EMF, 2014, p. 15). It is understood as an economic system that

represents a paradigm change in how society relates with nature; requiring disruptive innovations in legislations, production and consumption (Prieto-Sandoval et al., 2018).

The transition towards CE is a continuous state of adaptation, breaking paradigms, reviewing actions and operations (Kjaer et al., 2018), redesign structures and procedures (Ritzén & Sandström, 2017), and reinventing mindsets (CNI, 2018; Dufva et al., 2016). Reinventing mindsets means seeking new values to support a new culture to leverage disruptive innovations towards the CE. Creating more sustainable societies requires new mental attitudes capable of breaking paradigms and able to deal with complex, adaptive, and unpredictable behavior of ecosystems (van der Brugge & van Raak, 2007).

Thus, the CE transition efforts may be managed in the organization structure and in its business ecosystem as a whole, encompassing technical changes associated with the products, processes, business models, systems and metrics; as well in the organizational values, behaviors and competences. CE requires an environment that promotes the adoption of new technologies, encourages organizational learning and develops capabilities to overcome the barriers and resistance to change.

In order to achieve long-lasting changes and institutionalize CE, current organizational 'business-as-usual' cultures need to be challenged beyond technological or managerial systems changes. OC is based on values embodied in organizational norms, rules, standard procedures, and organizational goals. OC is defined as "the pattern of basic assumptions that a given group has invented, discovered, or developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid, and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems" (Schein, 1984, p. 3).

Culture is highly associated with organizational outcomes and is a root metaphor that conceptualizes what an organization is rather than what it has (Smircich, 1983). It has a fundamental role in hindering or fostering innovations, as affirmed by Schein, (1984, p. 3) OC "is the key to organizational excellence". However, frequently OC is not considered as an important factor to foster organizational changes and transformations. Schein, (1996) affirms that we fail to comprehend that culture is the most powerful force operating in organizations to maintain the system stability.

Various authors expressed the importance to understand and/or make adequate the OC to implement CE (Bashir & Verma, 2019; Bustinza et al., 2018; Isensee et al., 2020). Norms, values, visions, concepts, tools, instruments, and indicators should be checked and/or adapted in order for CE to become a paradigm in which industrial production and consumption will change in its roots (Korhonen, Nuur, et al., 2018). Despite the importance of soft aspects in the transition towards CE and all the efforts on developing the CE literature, organizational behavior is little explored (Chiappetta Jabbour et al., 2019; Korhonen, Honkasalo, et al., 2018).

Thus, the aim of this paper is to analyze what role plays the OC concepts in the transition towards the CE.

To achieve this goal, in the next sections we present the methodology used to develop this research, the results and discussion, and the conclusions.

Methodology

We conducted an exploratory literature review in databases and grey literature to identify previous studies that in some way brings the discussion of OC and its impact/role/function in the transition towards CE. We chose an exploratory review because CE is a new topic of research and few studies explicitly connecting CE with OC could be found. Since the scarcity of studies in this field, we conducted a single case study with 13 semi-structured interviews with managers and analysts from a multinational company in the steel and mining sector leader of steel production in Brazil. This company was chosen since they are an important company for the Brazilian economy. In addition, they are a company considered polluting by the sector in which they operate and even so they have been engaged in the journey towards CE. Figure 1 presents the

interviewed and other details about the conduction of the case study.

Figure 1. Details about the case study

Results & Discussion

Theoretical Findings

We observed through the literature that the transition towards CE is triggered by certain factors or events in the organizational environment or within the system itself (Geels, 2002; Savaget et al., 2019). Some studies highlighted that stakeholder, inside and outside the organization, are involved in the CE transition (Konietzko et al., 2019; Parida et al., 2019). The organizational perspective highlights the role of OC, leaders and other organizational members in CE transition (Davis & Boulet, 2016; Liu & Bai, 2014).

Building and sustaining a CE-oriented culture is particularly challenging for three reasons. First, a CE-oriented culture requires a combination of behaviors that can be risky for organization in the short-term. Second, leaders can face some resistance to change from the employees' side. Third, CE is a system of interdependent behaviors, inside and outside the organization and requires a systemic view for its implementation.

We gathered from literature some important factors for the proposition and/or maintenance of a culture oriented to CE, they are presented in Figure 2.

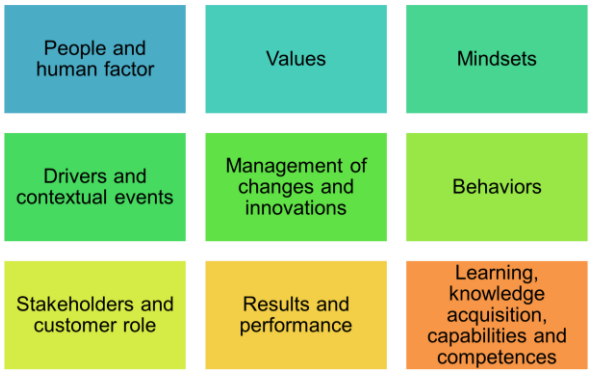

Figure 2. Factors for the maintenance of a CE-oriented culture[14]

These characteristics influence the behavior of employees towards new management systems and, what influences organizational performance. These new management systems are implemented through the acquisition of new capabilities and the development of competences.

An expressive number of companies that foster activities towards CE seek to duplicate well-succeeded business models. However, without the right mindsets it will result in unsuccessful changes. As expressed by *Bonchek & Libert, (2017)* we should change our mindsets before changing the actions.

Case Study Findings

Sustainability is a purpose for the company since they understand it as a way to perpetuate their business. Recently, they changed their

[14] *Source:* Chiappetta Jabbour et al., 2019; Bertassini et al., 2021; Ripanti & Tjahjono, 2019; Arponen et al., 2018; Agyemang et al., 2019; Konietzko et al., 2019; Arponen et al., 2018; Daae et al., 2018; Kunz et al., 2018; García-Machado & Martínez-Ávila, 2019; EMF, 2019; Khan et al., 2020

purpose from *“transforming tomorrow”* to *“production of more intelligent steel for a better world”*. This new purpose is highly aligned with CE, due to the fact that steel is the most recyclable material in the world (around 93) and they understand this characteristic as an enabler to reuse products and co-products in a way that is good for the environment.

According to the interviewed, the concepts of material circularity were always understood by the company due to the continuous steel recycling, and creation of by-products and co-products from steel. We observed that the sustainability reports are an important tool to spread the CE concepts inside and outside the organization. They can act as a communication channel to align the top management vision with the employees’ behaviors.

We also observed that sometimes there is a gap between what the top management team understands and what is put into practice by the employees. This means that in terms of CE concept there is a national and global understanding, however, in terms of practical application, CE remains restricted to recycling. Nonetheless, the interviewed affirm that in a ten years horizon, CE concepts will be more rooted and more developed than it is today due to the many initiatives that are being developed aiming to implement CE in the organization. More innovations occurred in the last 5 years around carbon reduction solutions. They make partnerships with other companies and universities to develop new innovative projects for sustainable and circular solutions. There are a lot of ongoing projects that largely demonstrate the adoption of CE within the company.

In terms of the organizational values that support the maintenance of a culture oriented for the CE, the interviewed said that sustainable development is a central value for the company. Reputation, transparency and business sustainability are values that guarantee the credibility of products and people in front of the stakeholders. Leadership, quality, health, security, and environment are also values expressed by people in the organization. However, values like innovation and creativity are not so well disseminated due to the fact that the company is still very traditional.

The organization has several actions for the creation of programs for the development of CE and sustainability. One program seeks continuous improvement and was structured for the areas to rethink their activities in order to implement sustainability. The goal is that this program has no end and becomes rooted in culture. Thus, there is continuous monitoring in order to understand how the values communicated by the top management have been deployed by the leadership and how it arrives at the employees.

According to the interviewed, culture is made through time, attitudes and materialized in actions. And in the case of a culture oriented to CE, it has been materialized through projects being developed and implemented and through team engagement and co-creation of solutions.

The company pursues some attitudes and behaviors that guide them in the path towards CE. They have weekly internal meetings for the presentation and evaluation of issues and resources regarding the development of CE projects. The company has defined some desired behaviors essential for the development of their new purpose, which are: openness, collaboration, empowerment, focus on the customer, and humility. Therefore, the company knows that there are beliefs that need to be worked on to create these behaviors, and these beliefs are: “the opinion of the other has value”, “we as a team are stronger than my individual opinion”, “if I work through the customer experience I can generate work that is more interesting for my employees as well”, “believe that employees are able to take ownership of their roles and regardless of hierarchy can have their contributions”.

Behind all this is the relationship of trust that must be the basis for generating the behaviors of the new culture. The company believes that when CE is communicated, collaboration is addressed in its broad sense: “company does not end in itself”. Thus, to create a viable business that impacts the ecosystem in a positive way, the company needs to look beyond its walls.

Leadership is essential for the transition towards CE. The top management has this role highlighted through the attitude of exemplarity, that is, the example comes from top to bottom. The leaders must transmit the CE values to the employees, who in turn deploy these values in behavior in the work and social environment in which they live; and for the other stakeholders that are part of the company. The top management has as its main role the allocation of resources and goals to make very clear the importance of CE for the entire organization.

Leadership has a fundamental role to demonstrate that CE is not just in paper, but a proposal for changing culture through the definition of goals, resources and internal strategies. Leaders have a great deal of power to make people behave according to what they see in leadership. The leadership's discourse must be aligned with the practice. If the leader does not treat CE as a priority and demonstrate this to the employees, it is unlikely that they will engage in developing actions towards CE.

Everyone in the company is trained in the basics of sustainability. All environmental projects and investments that are developed are communicated. The operational areas have specific goals to be fulfilled in relation to the master plans for each area. In this master plan, the areas have goals and what needs to be done to achieve this environmental goal.

In order to share the CE values and incorporate behaviors aligned to CE concepts the company develops capabilities around innovation, R&D and partnership across sectors. The company makes connections to develop and share new knowledge. When creating bonds and partnerships, it is possible to identify opportunities and this is the path towards CE.

The company always seeks to improve, to be at least at the same level as the competitors. They always seek the excellence of products and people. However, as in any change process, they identify gaps either in the skills or in the idea of proposing the necessary resources (financial, skills, competences).

The interviewed believe that the company still has a way to go in the transition journey towards CE. Today, they are a very successful company, but they know the successes that have brought them here are not necessarily the ones that will guarantee their position in the future. That is why the study of OC is so important. Around the transition towards CE, the company has already evolved, but to remain the first in steel, it has to evolve more. Concepts of CE and sustainability are rooted in the company, but it is still difficult to propose radical changes as they are a very traditional industry.

Conclusions

We observed that OC is essential for supporting long-lasting changes towards CE. This was confirmed by the literature findings and by the interviewed answers. We observed that the managers in the participant organization are aware of the impact that the wrong culture could have in the implementation of CE strategies; however, they also affirm that the organization must work harder and develop more organizational actions in order to disseminate a circular culture throughout its entire ecosystem. We concluded that OC highly impacts the transition journey towards the CE, and that organizations must put efforts in the change and adaptation of their culture towards one that supports CE.

We conducted a single and deep case study, what could be seen as a limitation of this study. As future research we recommend the conduction of multiple case studies with other organizations, in different stages of maturity levels towards CE, and from different sectors. This probably will result in a more systemic view about the role of OC in the implementation of CE by companies.

Acknowledgments

The authors gratefully acknowledge the financial support of the Brazilian research funding agencies CAPES (001) and FAPESP (2018/24830-6). The authors also gratefully acknowledge the company and the participants of the interviews.

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APPENDIX C – PAPER 3

Galetti, S. H. F., Stinder, A.K., Finke, S., Bertassini, A.C., Schelte, N., Severengiz, S., & Gerolamo, M. C. (2022). How can Product-as-a-Service practices be applied to the Battery-as-a-Service use case? 30th International Annual EurOMA Conference.

How can Product-as-a-Service best practices be applied to the Battery-as-a-Service use case?

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Abstract

Battery-as-a-service (BaaS) is an energy supply related form of Product-as-a-Service (PaaS) business model (BM) that is used in e-mobility use cases as a form to deal with one of the biggest sustainability challenges, the urban transportation. Although those kinds of BM are getting popular, the frameworks and guidelines to bring them into practice are in their infancy. Thus, this study aims to identify (i) best practices to implement PaaS and (ii) BaaS practices; and (iii) propose recommendations for the implementation of a BaaS using systematic literature review (SLR) and systematic global market research (SGMR). It was identified that client, processes and organizational PaaS best practices are the most used to implement BaaS, but the cultural best practices are forgotten, given space to the failure of the BaaS implementation in the long-term.

Keywords: Product-as-a-Service, Battery-as-a-Service, Circular Economy

Introduction

Promoting sustainability and the achievement of the sustainable development goals (SDGs) are one of the top priorities of governments and organizations around the world. Sustainability is the integration of environmental and social issues into the decision-making processes to improve the economic and social development in public and private sectors (WCED, 1987). According to the definition of Sustainable Development, the implementation of Circular Economy (CE) approaches is undoubtedly a necessity to give future generations the opportunity to meet their needs as well as current generations (Schroeder et al., 2018; Kristoffersen et al., 2021). CE practices are implemented through the so-called Circular Business Models (CBM). CBM aim to create, delivery and capture value (social, environmental and economic) through resource efficiency (Bocken et al., 2017). Product-as-a-Service (PaaS) is the most disruptive and powerful CBM that an organization could implement to get all the values that could be generated for CE implementation. PaaS seeks to dematerialize products and sell the outcomes that certain products could offer (BSI, 2017). Moreover, it promotes resource efficiency through the product life-cycle extension and closing cycles (Nußholz, 2017). PaaS implementation is supported by organizational design factors related to organizational culture, resource management and organizational structures (Gebauer et al., 2009). The PaaS implementation is characterized by the innovation of the capabilities and processes of an organization to create mutual value through a transformation from the selling of goods to the selling of the results that the goods offer (Baines et al., 2020).

PaaS could be applied in different sectors and solutions. An example is the case of Battery-as-a-Service (BaaS), an energy related form of PaaS. BaaS enables users to acquire an electric appliance without the battery and instead rent it from the provider ensuring the quality and the optimized use of the energy storage. BaaS is often used in e-mobility use cases to deal with one of the biggest sustainability challenges which are caused by urban transportation. Urban transportation is responsible for about one fifth of the global greenhouse gas (GHG) emissions (Richie 2020) which might be doubled until 2070 (IEA 2020). In addition, it is responsible for health issues which are caused from air and noise pollution (UBA 2022). Light electric vehicles (LEVs) sharing systems are discussed as a solution to reduce those emissions and provide access to mobility for everyone. According to Brost et al., (2022) there is an overall emission reduction potential of 44% for the entire passenger car emissions using LEVs. But inefficient energy supply systems such as the battery swapping with vans have a negative impact on life cycle emissions within the usage phase (Severengiz et al. 2020). Moreover, the acceptance of LEVs is restricted as potential users are concerned about limited range and high costs (Almannaa et al., 2021; Ho and Wu 2021; Kopplin et al., 2021). To increase a potential positive environmental impact, it is therefore important to focus on novel energy supply concepts which make energy supply available at any time. Thus, Battery Swapping Stations (BSS) are a possible solution as part of a charging infrastructure (Sarker et al., 2013). Access to BSS can be provided through BaaS. With an extensive network of BSS, BaaS concepts can provide an efficient energy supply for numerous applications and can help to address some of the fundamental challenges for the progress of electromobility such as range anxiety, long charging times, and high upfront investment costs. Therefore, sharing service users as well as private users should be able to drive to any BSS, swap the

low battery and park the shared vehicle at the location without worrying about the framework conditions.

The transition towards CE through the implementation of PaaS business models, such as BaaS, are getting popular among academia, policy makers and business. Nevertheless, the frameworks and guidelines to bring them into practice are in their infancy (Bocken et al., 2017; Sanchez-Planelles et al., 2022). PaaS implementation is increasingly becoming a combination of changing behaviour and technical challenges (Bertassini et al., 2021). Moreover, its implementation requires structured steps and guidelines to succeed and foster the transition process towards CE. Thus, this study aims to (i) identify best practices to organizations move towards a PaaS business model, (ii) identify BaaS practices that are already in use and (iii) propose recommendations for the implementation of a BaaS business model (BM).

Methodology

In this study we conducted: (I) An exploratory literature review on CE, PaaS and BaaS to identify the research problem, position the gap and propose the main research objectives; (II) A systematic literature review (SLR) aiming to identify best practices that are used as an enabler for the PaaS implementation. An SLR is a type of scientific investigation that aims to critically evaluate and perform a synthesis of results on multiple studies (Cook, D., Mulrow, C., Haynes, B. M. C, 1997). The search was conducted in the databases Scopus and Web of Science using a string[15] that incorporates "circular economy", "product-as-a-service", "best practices", "critical factors". In total, 58 articles were fully analysed through a content analysis that resulted in the identification of 46 theoretical PaaS best practices; III) A systematic global market research (SGMR) was carried out to identify the best practices used by BaaS companies. Therefore, a web search was performed with terms such as "Battery-as-a-Service", "BaaS", "battery renting", "battery leasing", "battery sharing" or "battery swapping" combined with terms such as "best practices", "concepts", "business model", "companies", "providers" or "electromobility". The results were characterized according to criteria of which system openness and scaling perspective are most important for a BaaS concept to have an impact on the transformation of mobile energy supply. Characterized criteria are the origin, the actual application, technology readiness, scaling perspective and system openness. To additionally ensure that the best practices are marketable the technological maturity is defined according to the technology readiness and the scaling perspective. This is defined after the European Union's technologies readiness level (TRL) with nine TRL criteria. Those are ascending requirements from basic principles for functional operation (TRL 1) to advanced criteria that reflect the actual confirmed application (TRL 9) (European Commission). In addition, the system openness is defined according to the interoperability with other systems and products. Which means that closed systems are only available for one application and open systems are available for different applications. (IV) Identification of the overlaps and similarities between the PaaS and BaaS best practices and a Business Model Canvas (BMC) was applied for the evaluation of the most promising best practices.

Results & Discussion

[15] The term 'battery-as-as-service' was not included in the SLR because the aim of the SLR was identify only generical PaaS best practices that could be implemented in any type of PaaS despite sector or application.

A total of 46 PaaS best practices were identified through the SLR, divided into: **client/customer:** that are focused on the process of communicating with and delivering value to the client; **cultural:** that are related to elements of the company's organizational culture: systematic and routine activities which are carried out by the organization or its members; **organizational:** that involve internal processes of the organization seeking to achieve circular objectives, such as managing CE goals through indicators; and **processes** that are related to the internal processes that take place within the organization, such as the processes of communicating with stakeholders. The best practices are presented in Tables 1 to 4.

Table 1: Customer best practices

Customer best practices	**References**
Establish long-term, trust and cooperative relationship with customers	(Adrodegari et al., 2017; Barquet et al., 2013; Camacho-Otero et al., 2018; Hanski et al., 2014; Kastalli et al., 2013; Kuo et al., 2010; Paiola; Gebauer, 2020; Sattari et al., 2020; Sjödin et al., 2020; Sousa-Zomer; Cauchick-Miguel, 2019)
Implement a service infrastructure to satisfy customer requirements by providing the services where they are needed	(Oliva; Kallenberg, 2003; Bustinza et al., 2015; Gebauer, 2020)
Identify customer(s) segments that will be addressed with the PaaS and customer segmentation criteria that helps to define and sale the new value proposition	Adrodegari et al., 2017; Bashir et al., 2020; Poponi et al., 2019)
Promote customer awareness and engagement about circular solutions	(De Pádua Pieroni et al., 2018)

Table 2: Cultural best practices

Cultural best practices	**References**
Form a coalition of trained, aligned and dedicated people to implement the circular economy	(Kuo et al., 2010; Latilla et al., 2021; Barquet et al., 2013; Duarte, 2014; Bocken; Geradts, 2020; Xavier et al., 2020)
Activate active participation of senior management and leaderships	(Kuo et al., 2010)
Maintain a flexible and responsive team and environment	(Bock et al., 2012)
Nourish a proactive attitude in employees to propose circular and sustainable solutions	(Bock et al., 2012)
Nourish circular organizational values (e.g. creativity, proactivity, innovativeness)	(Bock et al., 2012; Liao et al., 2018; Bertassini et al., 2022)
Nourish circular mindsets (e.g., open mindset, collaboration mindset, effectiveness mindset, life cycle mindset) inside and in the business ecosystem	(Barquet et al., 2013; Duarte, 2014; Bertassini et al., 2022)
Nourish an environment that stimulates collaboration, innovation, knowledge sharing, the outsourcing of non-core capabilities and focus on core ones, focus on results and on the customer	(Adrodegari et al., 2017; Barquet et al., 2013; Bettis; Prahalad, 1995; Carayannis et al., 2015; Duarte, 2014; Latilla et al., 2021; Liao et al., 2018; Resta et al., 2017; Schnürmacher et al., 2015; Turunen; Toivonen, 2011; De Wall, 2006)
Define objectives, adopt strategic tools and use technologies focused on decision-making that are aligned with CE principles and support the adoption of the PaaS	(Allais; Gobert, 2016; Bocken; Geradts, 2020; Kastalli et al., 2013)
Establish governance in the business ecosystem	(De Pádua Pieroni et al., 2018; Sousa-zomer; Cauchick-miguel, 2019)
Create a common organizational identity that strikes a balance between the economic, environmental, and social imperatives	(Stubbs, 2019)
Nourish a flexible and inclusive leadership	(Bashir et al., 2020; Fang et al., 2021; Liao et al., 2018)

Set company norms that encourage people to take an active position to achieve circular innovation goals	(Xavier et al., 2020)
Enable decentralization of authority for more collective decision-making processes and engagement of employees in the development of circular projects	(Latilla et al., 2021)
Coordinate and communicate with different business units to disseminate the innovation throughout the organization	(Latilla et al., 2021)
Nourish in the employees' values and behaviors that reinforce their ability to propose and participate in CE projects	(Kuo et al., 2010; Battilana; Lee, 2014)
Spread the CE culture through the business ecosystem	(Ghisellini; Ulgiati, 2020)
Create a commitment to sustainability and the CE transition within organization and business ecosystem	(Klein et al., 2021)

Table 3: Organizational best practices

Organizational best practices	**References**
Define circular performance indicators	(Hanski et al., 2014; Kastalli et al., 2013)
Create conditions for the proposition of circular and sustainable innovation across all areas of the organization	(Allais; Gobert, 2016; Bashir et al., 2020; Hanski et al., 2014; Huang et al., 2013)
Clearly define vision, mission and goals related to the CE	(Ghisellini; Ulgiati, 2020)

Table 4: Processes best practices

Processes best practices	**References**
Build stakeholder relationships based on trust, open interaction and shared commitment	(De Oliveira et al., 2018)
Collaborate with ecosystem stakeholders (e.g., share knowledge and resources)	(Abdulkader et al., 2020; Bellini et al., 2019; Kastalli et al., 2013)
Provide and acquiring knowledge and experience from outside	(Abdulkader et al., 2020)
Rewrite internal procedures and move away from the silos structure	(Latilla et al., 2021; Bock et al., 2012; Adrodegari et al., 2017; Allais; Gobert, 2016; Barquet et al., 2013; Kastalli et al., 2013; Abdulkader et al., 2020)
Provide clear and trustful contracts to the customers/users	(Allais; Gobert, 2016; Sattari et al., 2020)
Develop mechanisms to monitor the product's life cycle (e.g., product conditions; reverse cycle; resources flow)	(Barquet et al., 2013; Evans et al., 2017; Kastalli et al., 2013; Kuo et al., 2010)
Delegate business functions by using third-party operating facilities, establishing shared services agreements and contracting-out major projects to externalize peripheral functions while maintaining control and access to innovation	(Kastalli et al., 2013)
Consolidate activities by spinning-out or outsourcing activities	(Kastalli et al., 2013)
Customize the design, production and delivery of the solution for the clients	(Barquet et al., 2013)
Communicate with stakeholders to ensure transparency of actions	(Andersen et al., 2013)
Create separate business units to the PaaS implementation, with specific goals and quantifiable targets	(Gebauer et al., 2006)
Make long term contracts attractive for customers	(Besch, 2005)
Use technologies to improve services	(Adrodegari et al., 2017)
Set strategies and manage the activities related to the process of value creation, deliver and capture	(Adrodegari et al., 2017; De Oliveira et al., 2018; Sjödin et al., 2020)
Develop specific capabilities related to the service provided (e.g., new design, offering and pricing strategies)	(Davies, 2004; Resta et al., 2017)

Adopt strategies to close loops and generate value for longer time (e.g., reuse, remanufacture, refurbishment, resell)	(Ghisellini; Ulgiati, 2020; Rizzi et al., 2013; Vence; Pereira, 2019; Yang et al., 2018)
Use digital technologies to monitor flow of resources and products; digitalize the selling's; improve post-sale services and maintenance	(Camacho-Otero et al., 2018; Frank et al., 2019)
Use analysis and decision support tools to facilitate decision-making process	(Erguido et al.,2019)
Conduct extensive market research to clearly identify consumer needs, competitors, suppliers and factors that could interfere in the proposition of a PaaS solution	(Slavulj et al., 2020)
Use dynamic capabilities to intentionally adapt organizational resources to the changes in the ecosystem	(Abdulkader et al., 2020)
Establish PaaS, CE and sustainability friendly laws to form the main driving force of a sustainable society	(Kuo et al., 2010)
Establishing a long-term thinking	(Barquet et al., 2013)

The practices found in the literature are important to enable the adoption of the PaaS-BM and improve BM in companies that have already adopted PaaS. In addition, they can help promote better customer contact, as well as adequately prepare companies to handle their circular processes and measure sustainable goals during PaaS adoption. These PaaS best practices could or could not be applied to BaaS in electromobility organizations. Thus, to verify the similarities, overlaps and differences between the PaaS and BaaS best practices, we conducted a SGMR.

Within the SGMR, we identified nine BaaS best practices that are applied in some electromobility organizations. Five systems are from Asia, three from Europe and one from North America. Eight of nine BaaS best practices are BSS. Since two of these eight best practices are for cars, only six applications are considered for the micro mobility services. From those six, two case studies were selected for a closer observation due to their open systems, supporting various applications, and the resulting potential for upscaling.

The identified best practices indicate that the implementation of BaaS concepts is particularly promising for micro-mobility systems such as private and shared e-scooters or e-mopeds. These best practices were mapped into the BMC as shown in Fig. 1.

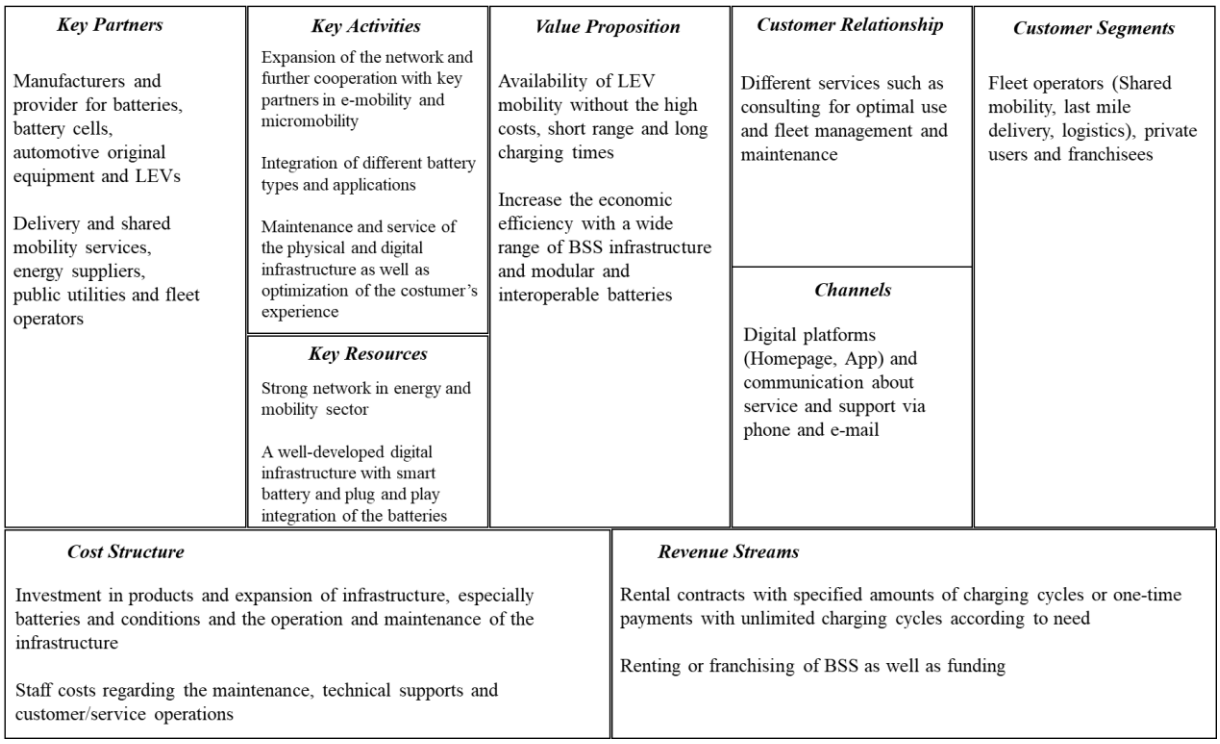

Figure 1: BaaS best practices mapped into the BMC

Table 5 presents some overlaps that were identified between the PaaS best practices and the BaaS best practices. Organizations with BaaS can implement other different PaaS best practices to improve their business and make it more circular. There is not that much development of practices related to the 'cultural' category of the PaaS best practices. That means, there is a risk of not long-lasting and less resilient organization. This would be necessary to avoid resistance from employees and other stakeholders regarding radical innovation required to this kind of CBM. Cultural best practices enable the organization to create awareness and alignment between all the involved in the BaaS implementation. Those are customers, suppliers, research centres, leaders, employees, and other actors. They should nourish proactive attitudes, mindsets, values and behaviours that are based on CE principles. Those create the willingness in the people to be involved in the implementation of new solutions of PaaS.

Table 5: Overlaps between PaaS and BaaS best practices

PaaS best practices	**BaaS best practices**
Customer/Client Long term relationships Service infrastructure Identification of segments Criteria for value proposition	**Customer Relationship** Different services such as consulting for optimal fleet use, fleet management and maintenance
	Customer Segment Fleet operators, shared mobility operators, logistics, last-mile delivery, private users
Cultural Coalition of people and participation of stakeholders	**Key activities** Network, cooperation with key partners, maintenance and service

<table>
<tr><td rowspan="2">Environment for active change management and innovation
Organizational identity</td><td>Value proposition
Availability of LEV mobility without high costs, short range and long charging time</td></tr>
<tr><td rowspan="3">Organizational
Conditions for circular and sustainable innovation
Vision, mission and goals</td><td>Key resources
Strong network (energy and mobility), digital infrastructure</td></tr>
<tr><td>Value proposition
Availability of LEV mobility without high costs, short range and long charging time</td></tr>
<tr><td rowspan="3">Processes
Stakeholder relationship and collaborative ecosystem
Experience from outside
Clear and trustful contracts, long term
Communication with stakeholders
Technologies to improve services
Develop specific capabilities</td><td>Key partners and Key resources
Manufacture, battery provider and LEVs, energy suppliers, public utilities and fleet operators, resulting in a strong network</td></tr>
<tr><td>Channels
Digital platforms and communication about service and support</td></tr>
<tr><td>Cost structure and revenue streams
Investment in products and expansion of infrastructure, rental contracts and franchising</td></tr>
</table>

The organizations could use the PaaS best practices as check-list to guide them in the journey of a CBM implementation. Initially, they could check which of the presented best practices they have and if there are some additional CE and/or PaaS that are important for their business but are not listed here. They could prioritize the practices and develop an action plan to implement those practices in the short, medium and long-term.

Back to the roots of operations management, it refers to the administration of the best practices to achieve maximum levels of effectiveness in terms of resources and capabilities. Thus, all the identified best practices give a vision to the companies of which components must be managed properly so that the companies remain profitable, competitive, and innovative towards CE transition.

Conclusion

The elaboration of a list with best practices for PaaS implementation can be used as a guide to foster the journey of companies towards a more circular and sustainable business. The best practices proposed in this study are generic and can be used by any company that are in the transition towards a PaaS business model.

This study contributes to the implementation of the BaaS business model by recommending best practices applied to CBM and generating greater academic production on the topic. First indications have been given how to create a BaaS business model with the BMC. Through standardization and interoperability BaaS systems have the potential to be more sustainable through minimized GHG emissions with a widespread application and system openness. Therefore, a comprehensive network of BSS systems with different service providers would be necessary. However, studies are focussed on BaaS for electric cars, but those are on the one hand very expensive and on the other hand very complex, which is why further research for micro mobility solutions is necessary. Also, further research should examine the specific economic feasibility of BaaS systems and especially discuss the integration into mobility sharing systems and combination with other energy services as well as the environmental and social implications to create sustainable business models. Overall, the BaaS best practices are limited due to the small selection of studies and applications.

Those creates a large research field about the advantages and disadvantages of BaaS for LEVs, the dependence on users' perceptions and quantification of potential and inhibitions.

Limitations of this paper are the theoretical contribution which requires a second stage of data analysis using deeper theoretical constructs to achieve more insights into the field. This reflects in future research that will be conducted. Moreover, in future research, sectorial studies could be conducted using the best practices identified.

Acknowledgements

The authors gratefully acknowledge the financial support of the Brazilian research funding agencies CAPES (001) and FAPESP (2018/24830-6 and 2021/01164-3). This work was supported during the ruhrvalley research project "SCiSusMob" (13FH0I73IA) supported by FH Impuls funding program of the German Federal Ministry of Education and Research. We also thank Moritz Fendler for his support.

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APPENDIX D – PAPER 4

Galetti, S. H. F., Bertassini, A.C., & Gerolamo, M. C. (2022). Análise das Barreiras Organizacionais para a Implementação de PaaS. XXIX SIMPEP – Resiliência na Cadeia de Suprimentos. https://www.simpep.feb.unesp.br/anais_simpep.php?e=17

ANÁLISE DAS BARREIRAS ORGANIZACIONAIS PARA A IMPLEMENTAÇÃO DE PAAS

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ÁREA: *9. ENGENHARIA DA SUSTENTABILIDADE*
SUBÁREA: *9.7 DESENVOLVIMENTO SUSTENTÁVEL*

RESUMO: *É NÍTIDO NO MUNDO EMPRESARIAL QUE EXISTE UMA FORTE TENDENCIA QUE SEGUE UMA PRESSÃO SOCIAL DE SE ANALISAR O IMPACTO SOCIOAMBIENTAL GERADO PELA FABRICAÇÃO DE UM PRODUTO OU OFERECIMENTO DE UM SERVIÇO. IMPLEMENTAR UMA MUDANÇA CULTURAL NÃO É SIMPLES: ENVOLVE REMODELAR COMPORTAMENTOS, O QUE É UM GRANDE DESAFIO NO CONTEXTO DA GESTÃO DA MUDANÇA. ESSE ESTUDO PRETENDE COMPREENDER MELHOR O MODELO DE NEGÓCIO DE PRODUTO-COMO-UM- SERVIÇO (PAAS), UM DOS MODELOS DE NEGÓCIO CIRCULAR QUE TEM MAIOR POTENCIAL DE ALAVANCAR A ECONOMIA CIRCULAR. ALÉM DISSO, TEM COMO OBJETIVO, ATRAVÉS DE UMA REVISÃO BIBLIOGRÁFICA SISTEMÁTICA (RBS) E DE UM ESTUDO DE CASO EXPLORATÓRIO QUE BUSCAM IDENTIFICAR QUAIS AS BARREIRAS, SOBRETUDO ORGANIZACIONAIS, ENCONTRADAS NA IMPLEMENTAÇÃO DO PAAS. ESSE ESTUDO OBTEVE COMO RESULTADO 18 BARREIRAS POR MEIO DA RBS E 6 BARREIRAS POR MEIO DO ESTUDO DE CASO EXPLORATÓRIO. ESPERA-SE COM ESSE ARTIGO, AUXILIAR OUTRAS ORGANIZAÇÕES A FAZER A TRANSIÇÃO PARA O MODELO DE NEGÓCIO DE PAAS E CONTRIBUIR PARA A ACADEMIA NAS TEMÁTICAS DE ECONOMIA CIRCULAR E MODELOS DE NEGÓCIO CIRCULARES.*

PALAVRAS-CHAVES: *ECONOMIA CIRCULAR; MODELO DE NEGÓCIO; PRODUTO-COMO-UM-SERVIÇO; BARREIRAS.*

ANALYSIS OF ORGANIZATIONAL BARRIERS TO PAAS IMPLEMENTATION

ABSTRACT: *IT IS EVIDENT IN TODAY'S BUSINESS WORLD THAT THERE IS A STRONG TREND OF CHANGE IN MOST CORPORATIONS BECAUSE OF THE EXPANDING PRESSURE TO ANALYZE THE SOCIAL AND ENVIRONMENTAL IMPACT GENERATED BY THE MANUFACTURING OF A PRODUCT OR THE OFFERING OF A SERVICE. TO IMPLEMENT A CULTURAL CHANGE ISN'T SIMPLE: IT ENVOLVES A BIG CHALLENGE IN CHANGE MANAGEMENT CONTEXT. THIS STUDY INTEND TO UNDERSTAND BETTER THE PRODUCT-AS-A-SERVICE BUSINESS MODEL (PAAS), ONE OF THE BUSINESS MODELS WITH MOST POTENTIAL TO LEVARAGE THE CIRCULAR ECONOMY. FURTHERMORE, IT HAS A PURPOSE, THROUGOUT A SISTEMATIC LITERATURE REVIEW AND WITH AN EXPLORATORY CASE STUDY THAT WILL IDENTIFY WICH BARRIERS, MAINLY THE ORGANIZATIONALS, FOUNDED IN THE PAAS IMPLEMENTATION. THIS STUDY HAD AS A RESULT 18 BARRIERS FOUND BY LITERATURE REVIEW AND 6 BARRIERS FOUND BY EXPLORATORY CASE STUDY. EXPECTED WITH THIS ARTICLE TO HELP OTHER ORGANIZATIONS TRANSITION TO THE PAAS BUSINESS MODEL AND CONTRIBUTE TO THE ACADEMY IN THE THEMES OF CIRCULAR ECONOMY AND CIRCULAR BUSINESS MODELS*

KEYWORDS: *CIRCULAR ECONOMY; BUSINESS MODEL; PRODUCT-AS-A-SERVICE; BARRIERS.*

1. INTRODUÇÃO

A Economia Circular (EC) se posiciona como alternativa ao atual modelo insustentável de produção e consumo (EMF, 2015) e como um conceito promissor para caminhar rumo a sustentabilidade (HOFMANN; KNYPHAUSEN- AUFSEß, 2022). O principal objetivo da EC se destaca como redefinir a noção de crescimento e sucesso: mudar de um foco em gerar benefícios para *shareholders* para a geração de benefícios para a uma variedade de *stakeholders* (BERTASSINI et al., 2021). O cumprimento desse objetivo está pautado em três princípios: eliminar resíduos e poluição desde o princípio, manter produtos e materiais em uso e regenerar sistemas naturais (EMF, 2015). A EC não é apenas um caminho individual para ações de *design* circular ou de reciclagem (GHISELLINI et al., 2016), mas sim para a criação de uma rede de atores, que por meio de ações conjuntas, tem o poder de desacelerar (diminuir) e fechar fluxos nos sistemas de produção e consumo (e.g., recusar, repensar, reusar, reparar, remanufatura, reciclar) (REIKE et al., 2018).

Muitos estudos enfatizam a importância dos modelos de negócio circulares (MNC) em acelerar a transição para uma EC (BOCKEN et al., 2018; LÜDEKE-FREUND et al., 2018). Os MNCs podem facilitar a implementação de estratégias circulares, pois eles têm o potencial de desencadear dinâmicas de mercado que abalam indústrias insustentáveis e lineares e, assim, reorganizam os processos organizacionais de sociedades inteiras rumo à circularidade,

incentivando novas colaborações entre diversos atores e moderando práticas circulares de produção e consumo (HOFMANN; JAEGER-ERBEN, 2020).

Um MNC pode ser definido como o modo como a empresa cria, captura e entrega valor com uma lógica projetada para melhorar a eficiência de recursos por meio do uso e da oferta de produtos, componentes e materiais que passam por múltiplos ciclos de uso (NUßHOLZ, 2017). Isso é alcançado por meio do desenho de fronteiras e mapeamento de relacionamentos interdependentes e estruturados entre uma organização principal e seu ecossistema circular (KONIETZO, 2020).

Conforme estabelecido pela BSI (2017), existem seis tipos de MNC que têm um potencial disruptivo para a circularidade, que são: produto como um serviço (PaaS), economia compartilhada e consumo colaborativo, recuperação da matéria prima e de subprodutos secundários, extensão do ciclo de vida de um produto, desmaterialização e vendas sob demanda. Dentre esses modelos apresentados, o modelo de negócio de PaaS é definido como o de maior potencial para a transição para a EC.

Segundo Goedkoop (1999), PaaS pode ser definido como um modelo de negócios, por meio do qual os fabricantes vendem produtos e serviços integrados contradizendo a lógica do oferecimento de produtos em isolado. Além disso, é uma forma de combinar um produto tangível e um serviço intangível projetados para atender as necessidades do cliente final (TISCHNER et al., 2002). A implementação do modelo de negócio PaaS é chamada de servitização. A servitização é a inovação das capacidades e processos de uma organização para criar valor mútuo por meio de uma mudança da venda de produtos para a adoção do modelo de negócio de PaaS (BAINES et al., 2009). O conceito de servitização também é definido por Dubruc, Peillon e Farah (2014) como uma inovação organizacional que requer uma mudança de uma cultura voltada à manufatura para uma cultura voltada ao serviço. Sendo assim, é preciso compreender, além das mudanças técnicas/tecnológicas necessárias, as mudanças na cultura organizacional necessárias para que a adoção do PaaS seja viabilizada.

O conceito de cultura organizacional pode ser definido como um padrão de suposições básicas inventadas, descobertas ou desenvolvidas por um grupo específico à medida que o mesmo aprende a lidar com seus problemas de adaptação externa e integração interna e que funcionou bem o suficiente para ser validado e deve ser ensinado para os novos membros da organização como a maneira padronizada de pensar, sentir e resolver esses problemas (SCHEIN, 1984). A cultura organizacional pode agir tanto como uma barreira quanto como um impulsionador para a implementação de MNCs, como o PaaS. Entender como a cultura organizacional tem se posicionado (como barreira ou impulsionador) na transição para a EC é essencial, uma vez que com isso é possível definir ações mais certeiras para superar essa barreira ou usá-la como impulsionador. Além da cultura, existem outros inúmeros fatores que podem agir como barreiras ou impulsionadores para a implementação de um MNC. Como por exemplo o estudo de D'Agostin (2020) que mapeou barreiras relacionadas a implementação do PaaS, tais como a cultura de consumo instaurada na sociedade.

Para que o PaaS possa ser aplicado, é preciso que o processo de servitização e que as barreiras organizacionais enfrentadas nesse processo de adoção sejam compreendidas. Dessa forma, este estudo se propõe a responder questão de quais são as barreiras que podem ser enfrentadas no processo de implementação do PaaS?

Para responder essa questão, dois objetivos de pesquisa foram definidos: (i) consolidar uma lista de barreiras enfrentas na adoção do PaaS através da literatura; (ii) apresentar as barreiras enfrentadas na adoção do PaaS observadas em um estudo de caso.

Por meio de uma revisão sistemática da literatura e um estudo de caso exploratório, este estudo identificou 24 barreiras para a adoção do PaaS. As barreiras foram discutidas e analisadas na seção 4 e foi possível notar que muitas daquelas que foram observadas na RBS também constam pelo menos de maneira similar na tabela de barreiras observadas no estudo de caso. Dentro da seção, foram feitos contrapontos de como é possível superar essas barreiras, com base no apoio de literatura e em vivencias observadas no estudo de caso.

O restante deste artigo foi estruturado da seguinte maneira: seção 2 apresentada a metodologia utilizada como base para o desenvolvimento da pesquisa; seção 3 apresentando os resultados e discussões acerca do estudo; seção 4 apresentando as conclusões do artigo.

2. METODOLOGIA

Este artigo combinou o uso de (I) Revisão Bibliográfica Sistemática (RBS) com um (II) estudo de caso exploratório.

(I) Revisão Bibliográfica Sistemática: A RBS foi desenvolvida com o objetivo de consolidar o conhecimento existente na literatura em relação a intersecção do PaaS com aspectos mais '*softs*', no caso, a cultura organizacional e para identificar barreiras organizacionais que podem surgir no processo de implementação do PaaS como um caminho para a circularidade. A RBS é um tipo de investigação científica que tem por objetivo reunir, avaliar criticamente e conduzir uma síntese de resultados múltiplos primários (COOK; MULROW; HAYNES, 1997).

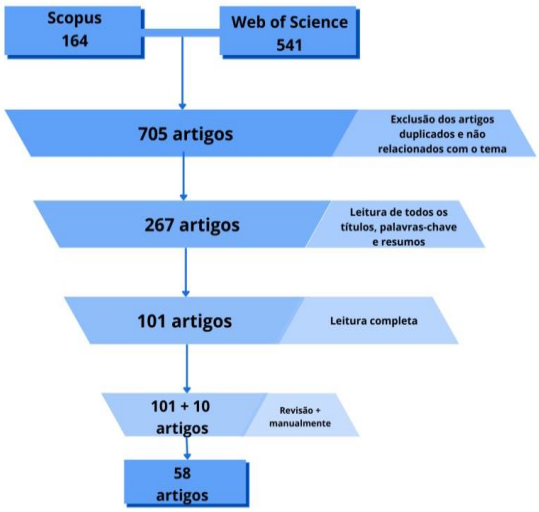
Foram definidas duas bases de dados para a realização da pesquisa: *Scopus* e *Web of Science*. A *string* de busca utilizada foi: *título: ("Product-as-a-service" OR "PSS" OR "Circular Economy" OR "Business Model Innovation" OR "Product service system") AND ("B2B" OR "B2C" OR "B2G" OR "Organi*ational Culture" OR "Values" OR "Organi*ational transformations" OR "Cultural analysis" OR "Business Model" OR "Transition management" OR "change management") AND ("Best practices" OR "Critical factors" OR "competitive advantages" OR "obstacles" OR "Barriers" OR "Innovation").*

A última busca nas bases de dados ocorreu no dia 23/08/2021 e foram selecionados inicialmente 705 artigos de periódicos e de conferências. Os filtros aplicados nas bases de dados para a seleção dessa amostra foram: o idioma de publicação deveria ser Português ou Inglês, os

artigos deveriam ser classificados como artigos, revisões, artigos de conferência ou revisões de conferência, os artigos precisavam pertencer a áreas de conhecimento como Administração, Negócios, Engenharia de Manufatura e Engenharia Industrial. Dessa amostra de 705 artigos, os que estavam duplicados (presentes em ambas as bases de dados) foram excluídos, bem como aqueles artigos que não continham nenhuma similaridade com a temática de pesquisa estudada; resultando em uma amostra de 267 artigos para análise. Com essa amostra, foi realizada a leitura do título, palavras-chave e resumo desses artigos, eliminando 166 artigos. Os 101 trabalhos que permaneceram na revisão foram lidos na íntegra junto a outros 10 artigos que foram adicionados manualmente na revisão através de referência cruzada. Por fim, foram extraídas barreiras de 58 artigos na revisão final. A Figura 1 sintetiza os passos seguidos para a condução da RBS.

O *software* "Start" desenvolvido pelo LAPES (UFSCAR) foi utilizado como apoio para a condução da RBS.

Figura 1: Estrutura da revisão bibliográfica sistemática



(II) Estudo de caso exploratório:

O estudo de caso pode ser definido como uma investigação empírica que analisa um fenômeno contemporâneo dentro de seu contexto da vida real (YIN, 2005). O estudo exploratório visa a descoberta de novos conhecimentos, devendo ter um planejamento de pesquisa flexível para poder levar em consideração todas as variações referentes a um caso. Nesta pesquisa, o estudo de caso foi realizado em uma empresa do setor de micromobilidade compartilhada e elétrica com sede localizada na cidade de São Carlos, que nasceu de uma proposta de valor circular. A empresa tem atuação em 24 cidades com serviços de compartilhamento e tem projeto de expansão para o compartilhamento de outros veículos elétricos além de patinetes. O protocolo de coleta de dados seguiu o formato de entrevistas semiestruturadas. As perguntas feitas aos entrevistados podem ser observadas na Tabela 1. Foram realizadas entrevistas com a alta gerência da empresa e visitas técnicas para que houvesse o entendimento do dia a dia dos funcionários e da aplicação do modelo de negócio dentro da empresa. As barreiras relacionadas ao estudo de caso estão dispostas na seção 4.

Tabela 1: Perguntas do questionário.

Nº	Perguntas
1	Como funciona a distribuição de patinetes da empresa X? É uma iniciativa totalmente privada, pode ser pública ou então pode ser da X?
2	Na questão regulamentar, quais são os maiores entraves que a empresa enfrenta?
3	Qual é o tipo de regulamentação envolvida no processo de instalação de rede de patinetes em determinada cidade? Isso varia de acordo com a esfera municipal, estadual ou federal?
4	Como é o processo logístico de instalação dos patinetes e bicicletas na cidade?
5	Como funciona o processo de manutenção da empresa X? Como funciona isso nas outras cidades que não tem sede da empresa?
6	Como funciona o planejamento estratégico dentro da empresa X?

Fonte: Elaboração própria

4. RESULTADOS E DISCUSSÕES

Com base nas entrevistas feitas no estudo de caso, que foi delineada a partir das perguntas que constam na Tabela 1, o entrevistado afirmou que o planejamento estratégico na empresa é concentrado em poucas pessoas da alta liderança e que os demais funcionários não têm muita ciência de como é feito. Além disso, o entrevistado também ressaltou que não há um alto desenvolvimento do setor de gestão de pessoas dentro da empresa. Isso mostra que o desenvolvimento que tange recursos humanos e gestão de conhecimento dentro da companhia não é exercitado da maneira que deveria.

A partir da RBS, foram identificadas 18 barreiras relacionadas à adoção do modelo de negócio de PaaS que estão dispostas conforme a Tabela 2.

Tabela 2: Barreiras para a adoção do PaaS.

Nº	Barreira	Referências
1	Aluguel de produtos	BARQUET et al., 2013

2	Dificuldade de alterar a direção organizacional e o foco da organização	KASTALLI; VAN LOOY; NEELY, 2013/VANDERMERWE, 1990/
3	Dificuldade de obter cooperação e aceitação dos clientes	VANDERMERWE; RADA, 1988
4	Dificuldade de mensurar serviços	WHITE et al., 1999
5	Resistencia interna à servitização	VANDERMERWE; RADA, 1988
6	Conflitos entre diferentes setores e diferentes hierarquias nas organizações	WHITE et al., 1999
7	Lacunas de liderança	CHESBROUGH 2007; SANTOS et al. 2009/BASHIR; NAQSHBANDI; FAROOQ, 2020/DUARTE, 2014
8	Concentração de autoridade em uma ou poucas pessoas	CARAYANNIS; SINDAKIS; WALTER, 2015/BASHIR; NAQSHBANDI; FAROOQ, 2020
9	Dificuldade em obter aceitação, coordenação e cooperação de diferentes atores, incluindo usuários/clientes	MONT, 2002
10	Falta de apoio de políticas, leis e regulamentos	KUO et al., 2010
11	Visão de curto prazo e linear	DE OLIVEIRA et al., 2018/BOCKEN; GERADTS, 2020; FRANK et al., 2019/MONT, 2002
12	Falta de alinhamento interno em relação a metas e valores sustentáveis e da criação de estratégias de forma integrada no sistema de gestão	STUBBS, 2019/XAVIER et al., 2020/ BASHIR; NAQSHBANDI; FAROOQ, 2020/ XAVIER et al., 2020
13	Desalinhamento nos processos de criação e captura de valor	SJÖDIN et al., 2020
14	Falta a compreensão de como projetar propostas de valor para o cliente na economia circular e que tipo de valor superior elas prometem aos beneficiários-alvo.	RANTA; KERÄNEN; AARIKKA-STENROOS, 2020

15	Má gestão e falta de controle das informações	BASHIR; NAQSHBANDI; FAROOQ, 2020
16	Falta de informações de mercado	BASHIR; NAQSHBANDI; FAROOQ, 2020
17	Desalinhamento entre a estrutura organizacional e a estratégia de negócios	XAVIER et al., 2020
18	A inércia organizacional tem uma influência negativa significativa na inovação aberta	HUANG et al.,2013

Fonte: Elaboração própria

Além das barreiras listadas na Tabela 2, que foram obtidas por meio da revisão de literatura, também foram obtidas barreiras por meio do estudo de caso exploratório, que estão dispostas conforme a Tabela 3.

Tabela 3: Barreiras do estudo de caso exploratório.

Nº	Barreira
1	Falta de um planejamento estratégico bem definido e transparente dentro da empresa.
2	Ausência de um setor de RH presente dentro da empresa.
3	Concentração das tarefas estratégicas da empresa.
4	Falta de educação do cliente voltada à sustentabilidade.
5	Falta de um plano bem definido para monitorar o ciclo de vida do produto.
6	Dificuldades de alinhamento entre a empresa e órgãos públicos legislativos.
7	Desejo de posse do cliente acerca do produto.

Fonte: Elaboração própria.

É possível analisar que tanto na Tabela 2 quanto na Tabela 3, existem barreiras relacionadas ao comportamento do cliente, como por exemplo as barreiras 3 e 9 da Tabela 2, que dizem respeito a uma dificuldade de cooperação e envolvimento do cliente com o modelo de negócio e com a sustentabilidade. E as barreiras 4 e 7 da Tabela 3, que dizem respeito à falta de educação do cliente voltada a sustentabilidade e ao seu comportamento de desejo de possuir o produto. Essas barreiras obtidas por meio do estudo de caso podem validar e complementar ou explicar aquelas obtidas por meio da RBS, visto que a dificuldade de cooperação do cliente pode se dar em desdobramento de uma falta de educação sustentável do cliente. Isso pode ser superado com o oferecimento de vídeos educativos por parte da empresa, explicando os benefícios do MNC e do serviço ofertado bem como seus impactos positivos no meio ambiente, como exemplifica Kastalli,

Van Looy e Neely (2013) de criar relações diretas com o cliente para intensificar o contato ou aumentar sua frequência e ter o controle das informações passadas para eles.

Também existem barreiras que se relacionam a estrutura organizacional vigente da empresa ou a processos internos dentro dela, como as barreiras 2, 5, 6, 7, 8, 11, 12, 13, 14, 15, 17 e 18 da Tabela 2 e as barreiras 1, 2, 3 e 5 da Tabela 3. Muitas dessas barreiras se relacionam diretamente à alta gestão e liderança das empresas, como por exemplo a ausência de um planejamento estratégico e a concentração de tarefas ou hierarquia dentro da empresa, visto que essas funções são relacionadas a lideranças das empresas, além de se relacionar também ao alinhamento quanto a visão de longo prazo. Isso pode ser um grande reflexo da falta de alinhamento interna a respeito do MNC e das metas voltadas a sustentabilidade. KUO et al (2010) sugere, por exemplo, que haja um envolvimento ativo das lideranças durante a implementação do PaaS, além de também ser necessário haver ume descentralização de autoridades e a geração de um sentimento de "fazer parte" em todos os funcionários da organização (LATILLA et al.; 2021).

Uma das barreiras citadas é a 11 da Tabela 2, que se refere ao pensamento de curto prazo instaurado dentro das organizações. Por se tratar de um modelo de negócio novo e que envolve o oferecimento de serviços, o retorno financeiro e do sucesso da organização é majoritariamente de longo prazo. Barquet et al. (2013) cita a importância de ser realizado um planejamento que visa o crescimento a longo prazo e de não ter parte dos investimentos e projetos com objetivos de resultados imediatistas.

5. CONCLUSÕES

Este estudo apresenta as barreiras organizacionais enfrentadas por empresas no processo de implementação do PaaS. Tais barreiras foram identificadas com base em duas metodologias bem consolidadas: a revisão bibliográfica sistemática e o estudo de caso exploratório. As barreiras obtidas são complementares, visto que as barreiras encontradas no estudo de caso servem para efeito de validação daquelas encontradas RBS, que é majoritariamente teórica. Foram apresentadas algumas sugestões, com base nas próprias barreiras e nas vivências do estudo de caso, com o intuito de superar as barreiras apresentadas e auxiliar as empresas no processo de adoção do MNC. Com esse estudo é possível auxiliar no fomento do tema dentro da academia como também auxiliar empresas que já possuem o MNC de PaaS ou que desejam passar pelo processo de servitização a fazê-lo.

Além dos benefícios para a academia e para o ramo na empresa, o estudo contribui também indiretamente à Economia Circular, visto que está auxiliando na promoção de um modelo de negócio que tem um grande potencial de circularidade.

Agradecimentos

Os autores agradecem a Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) - processos 2021/01164-3 e 2018/24830-6 – por dar suporte ao desenvolvimento desta pesquisa.

As opiniões, hipóteses, conclusões, e recomendações expressadas nesse material são de responsabilidade dos autores e não, necessariamente, refletem a visão da FAPESP.

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APPENDIX E – PAPER 5

Barboza, L.L, Bertassini, A.C., Gerolamo, M. C., & Ometto, A.R. (2022). Organizational Values as Enablers for the Circular Economy and Sustainability. Revista de Administração de Empresas, 62, e2021-0331. https://www.scielo.br/j/rae/a/dx8jkMXxjywTGrKS36nyFqc/

FORUM

Submitted 05-18-2021. Approved 11-182021.
Evaluated by *double-blind review process*. Guest Editors: Carla Curado, Lucía Muñoz-Pascual, Mírian Oliveira, Paulo Lopes Henriques, Helena Mateus Jerónimo.
Original version |

ORGANIZATIONAL VALUES AS ENABLERS FOR THE CIRCULAR ECONOMY AND SUSTAINABILITY

Valores Organizacionais como Suporte para a Economia Circular e Sustentabilidade

Valores Organizativos como Apoyo para la Economía Circular y Sostenibilidad

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ABSTRACT

The transition towards the circular economy (CE) requires that organizational values be examined in more depth and understood more fully, which can encourage innovation and sustainable attitudes. The majority of the studies on this matter, however, only address the technical aspects of the transition to a CE. The aim of this paper was to identify and analyze those organizational values that are essential for sustaining a culture that incorporates concepts of circularity and sustainability. Using a multi-method approach, we identified a list of 29 circular values and proposed a definition for each one. The values identified were discussed with regard to their importance in achieving sustainability. By way of a case study we also exemplified the adoption of circular values and how the specific organization we studied is nurturing those values. This seminal study enriches discussion of the importance of soft factors for the transition to a CE. It also embraces the relevance of human resource management in organizations for boosting sustainability.

Keywords: circular economy, Organizational Culture, Organizational Values, Sustainability, Innovation.

RESUMO

A transição para a Economia Circular (EC) requer o aprofundamento e a compreensão dos valores organizacionais, os quais podem estimular e encorajar inovações e atitudes sustentáveis. Entretanto, a maioria dos estudos aborda majoritariamente aspectos técnicos para essa transição. Portanto, o objetivo deste artigo foi identificar e analisar valores organizacionais essenciais para sustentar uma cultura que incorpore conceitos de circularidade e sustentabilidade. A partir de uma abordagem multimétodo, identificamos 29 valores circulares e propomos a definição de cada um deles. Os valores identificados foram discutidos em relação à sua importância para alavancar a sustentabilidade. Ademais, exemplificamos, por meio de um estudo de caso, a adoção de valores circulares e como essa organização específica está nutrindo esses valores. Este estudo seminal enriquece a discussão sobre a importância de soft skills *para a transição para a EC. Além disso, ele fomenta a relevância da gestão de recursos humanos nas organizações para impulsionar a sustentabilidade.*

Palavras-chave: *economia circular, cultura organizacional, valores organizacionais, sustentabilidade, inovação.*

RESUMEN

La transición hacia una economía circular (EC) requiere una profundización y comprensión de los valores organizativos, que pueden estimular y fomentar las innovaciones y actitudes sostenibles. Sin embargo, la mayoría de los estudios abordan los aspectos técnicos de esta transición. Por lo tanto, el objetivo de este artículo fue identificar y analizar los valores organizativos que son esenciales para sostener una cultura que incorpore circularidad y sostenibilidad. Utilizando un enfoque multimétodo, identificamos 29 valores circulares y propusimos una definición para cada uno de ellos. Los valores identificados se debatieron en relación con su importancia para la sostenibilidad. Además, ejemplificamos con un estudio de caso la adopción de valores circulares y cómo esa organización está desarrollando esos valores. Este estudio seminal enriquece el debate sobre la importancia de soft skills para la transición a la EC. Además, fomenta la relevancia de la gestión de los recursos humanos para impulsar la sostenibilidad.

Palabras Clave: *economía circular, cultura organizativa, valores organizativos, sostenibilidad, innovación.*

INTRODUCTION

Human activity worldwide has been causing different social and environmental problems and increasing the pressure from consumers, society, governments, and the market for more sustainable businesses, a situation that is directly affecting the strategic orientation of organizations. Since the linear “take-make-dispose” economic model is facing worsening challenges (Ellen MacArthur Foundation [EMF], 2012), the circular economy has been gaining the attention of organizations. CE is a viable way of redefining the concept of economic growth, with a focus on ensuring greater effectiveness in the use and management of resources, environmental quality, inclusiveness, and the well-being of populations (Cotec, 2016). It is an economic model based on shared values and a long-term systemic vision (Confederação Nacional da Indústria [CNI], 2018). It can create sustainable value, since its

implementation enables adverse impacts to be minimized while including new ways of doing business (Buren, Demmers, Heijden, & Witlox, 2016). It also has a direct relationship with sustainable development and can contribute to the achievement of the sustainable development goals (SDGs) that were established by the United Nations (UN) (Schroeder, Anggraeni, & Weber, 2018).

Most definitions of CE have in common the optimization of the value of products, components and materials (Bocken, Pauw, Bakker, & Grinten, 2016; EMF, 2012; Prieto-Sandoval, Jaca, & Ormazabal, 2018), which is reflected in process changes. The transition towards circularity, however, requires more radical changes and innovations in business models and ecosystems for it to be effective, since the CE operates at the micro (products, enterprises, and consumers), meso (industrial ecoparks) and macro (cities, regions, nations) levels (Kirchherr, Reike, & Hekkert, 2017). The implementation of innovations in business models for a CE requires simultaneous changes in structures, processes, technologies, mindsets, culture and ecosystems (Bocken, Schuit, & Kraaijenhagen, 2018; Konietzko, Bocken, & Hultink, 2020; Pieroni, McAloone, & Pigosso, 2019); that is, in order to develop sustainable and circular business models, organizations must reinvent themselves and adapt different aspects, including proposing a culture that incorporates circular and sustainable concepts and strategies (Gue, Promentilla, Tan, & Ubando, 2020).

Organizational culture (OC) is a key element for supporting changes for achieving a CE, since corporate culture transmits a sense of identity and, through beliefs, values and norms, determines how to do business (O'Donnel & Boyle, 2008). OC can be defined as:

> "The pattern of basic assumptions that a given group has invented, discovered, or developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems. (Schein, 1984, p. 3)."

In order to achieve the organizational changes required for a CE, it is important to consider not only the different levels of the organization (individuals, groups and the organization as a whole) (Lloria & Moreno-Luzon, 2014), but also the interrelationships between individuals and their capacity to adapt to their particular environment. Organizational changes depend on the acceptability of individuals and will be more effective

if perceived as being central to the organization's survival (Buchanan et al., 2005; Dawson, 1994).

Organizational values, as the "heart of the culture of an organization" (Posner, 2010, p. 536), are generally the basis for integrating essential performance and operational requirements into a results-oriented structure (Lagrosen & Lagrosen, 2019) and, therefore, they must be clearly communicated and shared. Furthermore, these values can guide innovation, since they influence organizational behavior and constitute motivational goals (Miguel & Teixeira, 2009).

Several authors have expressed the importance of adapting the OC to implement the CE (Bashir & Verma, 2019; Bustinza, Gomes, Vendrell-Herrero, & Tarba, 2018; Isensee, Teuteberg, Griese, & Topi, 2020). Norms, values, visions, concepts, tools, instruments, and indicators should be checked and adjusted in order to enable the CE (Korhonen, Honkasalo, & Seppälä, 2018). Despite the importance of cultural aspects in the transition towards a CE and all the efforts required to develop the CE literature, the OC and the values that support the transition to a CE are little explored (Jabbour et al., 2019; Korhonen, Nuur, Feldmann, & Birkie, 2018). There are just two studies in literature that clearly address discussions about a CE-oriented culture (Bertassini, Ometto, Severengiz, & Gerolamo, 2021) and circular organizational values (Barboza, Bertassini, Gerolamo, & Ometto, 2020).

Therefore, considering the scarcity of studies in the field and the importance of understanding the values that support an OC that addresses the specifics of the CE, this paper aims to: (i) identify those organizational values that support the development of a CE-oriented culture; (ii) discuss the importance of identifying circular organizational values for sustainable development; and (iii) exemplify, by way of a case study, the adoption of circular values and how a specific organization nurtures those values. This is done to encourage organizations to move towards a CE based on aspects inherent in the individual and collective unconscious.

METHODOLOGY

This research adopts a multi-method procedure (i.e., "research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative

and quantitative approaches'' (Tashakkori & Creswell, 2007, p. 3)) based on the phases proposed by Bardin (2011) in his content analysis theory. Content analysis comprises a set of analysis techniques to obtain, by systematic and objective content description procedures, those indicators that allow knowledge to be inferred. According to Duncan (1989), the content analysis method "lies at the crossroads of qualitative and quantitative methods" (p. 27); therefore, it enables different techniques to be combined.

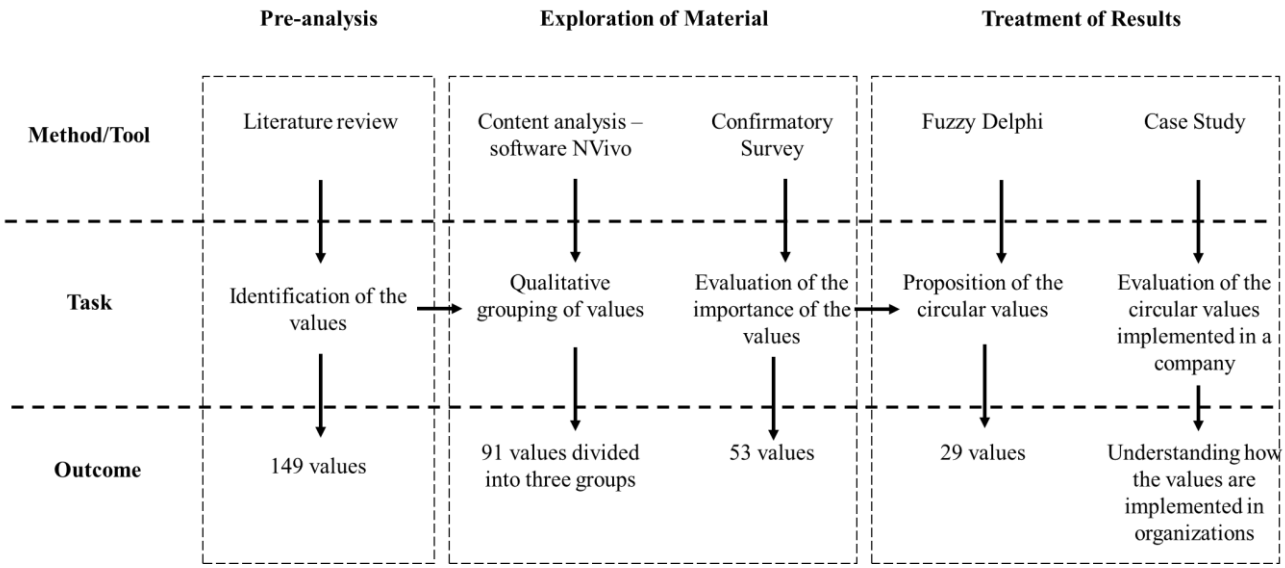
Combining quantitative and qualitative methods can boost the strengths and perspectives of each method, especially with regard to an unknown phenomenon (Johnson & Onquegbuzie, 2004; O'Cathain, Murphy, & Nicholl, 2008; Östlund, Kidd, Wengström, & Rowa-Dewar, 2011), and provide a better approach and the potential to widen the repertoire of traditionally-used research methods (Creswell & Clark, 2007; Molina-Azorin, 2016). In this study, this combination plays an important role, since we are dealing with a field that is complex and with regard to which there is limited literature.

This study evaluated the topic in diverse dimensions in order to increase the reliability of the results, and to encompass the benefits outlined by Greene, Caracelli and Graham (1989) and Molina-Azorin (2016): complementarity (integrating the results/analysis of one method with the findings from another); development (the contribution of the results of one method towards helping with the development of another); and expansion (extending the breadth and scope of research using different methods).

The qualitative data were collected before the quantitative data in this study in order to first explore and investigate the research problem, and then to analyze it from a quantitative perspective that is amenable to study (Molina-Azorin, 2016). In order to ensure the validity of the answers their theoretical and qualitative content was consolidated following evaluation by experts in the subject, who quantitatively analyzed the data using methods that are recognized in the literature for the application of questionnaires.

The phases followed in this study are presented in Figure 1 and described in detail in the next subsections.

Figure 1. **Outline of the methodology applied in this study**



Pre-analysis

The procedures adopted in this phase were well-defined to cover the initial contact with the literature for formulating the hypotheses and indicators that contribute to the study's development (Câmara, 2013). Due to the novelty of the theme, a systematic review of literature was unsuitable, so the authors opted for an exploratory review that could result in more information and better results.

We consulted company reports, literature cases and the institutional websites of organizations that already adopt sustainable and circular practices and mindsets, such as members of the Ellen MacArthur Foundation's Circular Economy 100 Program (established to enable organizations to develop new opportunities and rapidly achieve their ambitions in the CE), and those recognized by The Circulars (the world's premier CE awards). We also searched for organizational values in academic literature related to the CE, such as sustainability, innovation, change management, recycling, waste management, renewable energy, eco-design and Industry 4.0. As a result, we identified and defined 149 preliminary organizational values that could be related to the CE.

Exploration of the material

In this phase the data were systematically transformed and aggregated into categorization units (Santos, 2012) in order to allow for interpretations and inferences to de developed. We

used the NVivo software to code the data qualitatively and a confirmatory survey involving CE experts.

Application of the NVivo Software

NVivo was used to analyze and filter the organizational values we identified. This software is used for analyzing qualitative information, which enables textual data to be organized and categorized by analyzing words, sentences and/or paragraphs (Silva, Figueiredo, & Silva, 2015).

The definitions of the 149 organizational values previously identified were used as input. Using the NVivo results and after thorough analysis, the values were grouped by similarity of definition and a preliminary categorization was proposed according to the relationship of the values with the process of the transition towards the CE and with circular principles:

- **Group 1:** Values that are basic to any company, whether they target the CE or not.
- **Group 2:** Values related to the transition process towards the CE, that is, those that are essential for proposing any kind of change and/or innovation.
- **Group 3:** Values related to the future state of a circular company, that is, those that are essential for supporting a circular organizational culture.

This preliminary treatment of the data enabled us to reduce the number of identified organizational values to 91.

Confirmatory survey

A confirmatory survey was carried out to validate the grouping of the organizational values. According to Forza (2002), a confirmatory survey aims to test the appropriateness of the content, hypotheses, and concepts that are developed in relation to certain phenomenon.

The survey was developed on the Google Forms platform and, in the period between May and August 2020 (a long period because of the COVID-19 pandemic), sent to theoretical and practical experts in the CE and sustainability fields. To identify the target audience, we looked for contacts in scientific articles related to the CE, company reports, social media, university research groups, and others. We also used the “snowballing” method, which is a research technique that is recommended when the population cannot be strictly delimited or

detailed, thus aiming to identify other individuals of interest for consultation (Dragan & Isaic-Maniu, 2013). This method includes the researchers' identifying individuals for interview, who, in turn, must indicate/recommend other interviewees who can contribute to the research.

Survey respondents were asked to classify the 91 values on a Likert five-point scale (from 0 to 4) in relation to the importance of the value for the transition to the CE, based on BSI 8001 (0= Unimportant; 1= Not very important; 2= Moderately important; 3= Important; 4= Very important) - See Appendix 1. A total of 60 valid responses were collected. The demographic data are shown in Table 1. The sample of respondents was sufficient to achieve the aim of its application because a very specific group of experts was chosen to answer the questionnaire.

Table 1. **Distribution of the demographic profiles**

Demographic Group	**Variables**	**Frequency n=60**	**%**
Gender	Female	28	46.7
	Male	32	53.3
Age	24-30 years old	17	28.3
	31-37 years old	12	20.0
	38-44 years old	13	21.7
	45-51 years old	9	15.0
	> 51 years old	9	15.0

Location	Brazil	40	66.6
	Denmark	4	6.6
	Italy	3	5.0
	United Kingdom	3	5.0
	Colombia	2	3.3
	The Netherlands	2	3.3
	Albania	1	1.7
	Australia	1	1.7
	France	1	1.7
	Lebanon	1	1.7
	Spain	1	1.7
	Taiwan	1	1.7
Workplace	Educational Institution	54	90.0
	Private Company	6	10.0

The data were statistically treated using the IBM SPSS Statistics software for carrying out statistical, predictive, descriptive, prescriptive, and regression analyses. We also performed frequency and descriptive statistical analyses (mean, median, mode, error deviation, variance, sum and percentiles).

In addition to descriptive statistics tools, the Binomial Hypothesis Test was applied according to Gosavi (2015). When applying the Likert scale, it is often interesting to determine how many respondents are on each of the sides, or whether there was a statistical tie. The Binomial Test facilitates this analysis by providing a test of statistical significance. To apply this test, for each organizational value evaluated by the respondents, we combined the answers at Levels 3 and 4 into one group (Group 1) and the Level 0 and 1 answers into another group (Group 2). Level 2 was considered "neutral". The significance level (α) we adopted was 0.05.

Considering *pi* to be the estimated proportion of the population belonging to Group *i*, and *Li* is the number in the *i-th* group (Gosavi, 2015), in this study we assumed that L1≥L2. Taking these facts into consideration, we tested two hypotheses to evaluate the disposition of the survey data:

- H0: $p1 \leq p2$ (null hypothesis).
- H1: $p1 > p2$.

We calculated the confidence intervals using the Binomial Test, and if they do not overlap the null hypothesis can be rejected and the group with the highest number of respondents can be considered the "winner" in a statistical sense. On the other hand, if the confidence intervals overlap, the null hypothesis cannot be rejected and no definite conclusions can be drawn (Gosavi, 2015).

In general, if the null hypothesis was rejected at the established confidence level, we could state that the number of respondents who assessed the value as being "Important" or "Very Important" (Levels 3 and 4) for the transition to the CE exceeded the other levels. If the null hypothesis was not rejected, however, no definitive conclusions could be drawn.

Therefore, by applying the confirmatory survey, we were able to filter the initial list of values and identify 53 organizational values that were assessed as being important for innovation and for the transition towards the CE. However, since the results of some values were very heterogeneous, and we were consequently unable to reach a definitive conclusion, we had to apply a new filter to validate the data and obtain a more reliably consensual result.

Treatment of the results

This phase involved the inference and interpretation of the results to make them significant and valid (Câmara, 2013). According to Bardin (2011), this phase comprises a moment of intuition and reflective and critical analysis. We used the Fuzzy Delphi Method and a case study to validate the results.

Fuzzy Delphi Method

The Fuzzy Delphi Method (FDM) is a combination of the fuzzy theory and the traditional Delphi Method for considering human linguistic preferences in decision making (Saffie, Shukor, & Rasmani, 2016). This method makes it possible to capture vague information and convert it into a numerical format, which is simpler to handle. While predictions in the traditional Delphi Method are based on answers obtained from a panel of experts in two or more rounds until these answers converge, in the FDM the decision process is faster and eliminates the need for multiple rounds (Raut & George, 2018). Answers are analyzed using fuzzy numbers, which reduces the error level.

The 53 values we previously identified in this study were analyzed by eight CE experts (part of the CE Research Centre at the University of São Paulo) using the FDM. We developed a questionnaire, in which the experts were asked to rate the degree of importance of each of these values for sustaining a CE-oriented OC on a Likert Scale from 1 to 5 (1 = Not important; 2= Not very important; 3 = Moderately Important; 4 = Important; 5 = Very Important / Essential). We applied and analyzed the questionnaire in September 2020.

The experts' answers were converted into triangular fuzzy numbers to identify the level of agreement with each item, as shown in Table 2. In general, the triangular fuzzy number consists of a fuzzy number that is displayed with three real numbers (F= (L, M, U)), where the upper bound, U, is the maximum value of the fuzzy number, the lower bound, L, is the minimum value of the fuzzy number, and M is the largest probable value of a fuzzy number (formal crisp value for the fuzzy set) (Habibi, Jahantigh, & Sarafrazi, 2015).

Table 2. **Triangular fuzzy numbers considered in this study**

Not important	**Not very important**	**Moderately important**	**Important**	**Very important/ Essential**

(0.0; 0.0; 0.25)	(0.0; 0.25; 0.5)	(0.25; 0.5; 0.75)	(0.5; 0.75; 1.0)	(0.75; 1.0; 1.0)

After *fuzzification*, the experts' answers were aggregated (Fuzzy Aggregation - FA) from an average of each expert's triangular numbers, as shown in (1):

$$FA = \frac{\sum\ L}{n}, \frac{\sum\ M}{n}, \frac{\sum\ U}{n} \qquad (1)$$

Defuzzification was then performed in order to obtain the best average, that is, to convert the fuzzy values into clear and understandable numbers. There are different methods for this, but in this study, we used the Center of Area (CA) formula (2), where F*i* is the fuzzy aggregation for the limit *i*.

$$CA = \frac{|(FU-FL|-|FM-FL|}{3+FL} \qquad (2)$$

Finally, to analyze the results obtained with the CA formula, we established four levels of evaluation (Strong, Moderate, Weak, and Nonexistent) according to the relationship of organizational values required for supporting an OC that focuses on the CE (See Table 3). We selected these ranges taking into consideration the average cutoff value of 0.5 according to the literature (Saido, Siraj, DeWitt, & Al-Amedy, 2018; Yusoff, Hashim, Muhamad, & Hamat, 2021).

Table 3. **Cut-off values for analyzing the results**

Relationship sustaining a CE-oriented OC	**Between**	
	>	≤
Strong	0.8	1.0
Moderate	0.5	0.8
Weak	0.2	0.5
Nonexistent	0.0	0.2

We rated 29 values as having the strong relationship needed for maintaining a CE-oriented OC (i.e., CA>0.8). These values are emphasized in this paper as being circular organizational values, i.e., essential organizational values for sustaining a circular OC.

Case study

Since few real cases have ever been published that explicitly set out the circular values that an organization has for developing its culture and establishing the path to the CE, between April and August 2020 we carried out a single case study in a multinational company in the steel and mining sector that is a leader in steel production in Brazil. A case study is a "comprehensive description of an individual case and its analysis" (Starman, 2013, p. 31), the aim being to identify variables, structures, forms and orders of interaction among the participants in a "real life" setting, which enables comparisons to be made with a theoretical analysis (Simons, 2009; Starman, 2013).

We have not been allowed to disclose the name of the company, so we are calling it 'Alpha'. We chose this company because of its importance to the Brazilian economy and its sustainable and circular initiatives. The sector in which the company operates is considered to be one of the most polluting, but the company is engaged in socio-environmental responsibility initiatives and has different projects, actions and mindsets in favor of sustainability and the CE, which stimulate the role that steel can play in a low-carbon circular economy for fostering sustainable development.

Our objective in applying this case study was: to exemplify whether the values that a real organization that wants to be circular has are indeed circular; and to identify the circular values the company is implementing and how it is implementing them. In conducting the case study, we combined interviews and document analysis. We carried out 13 semi-structured interviews with managers and analysts (see Figure 2 and Appendix II). We selected only people who work directly with sustainability and CE in the organization to take part in the interviews in order to have a more focused understanding of the organization's panorama of circular values.

Figure 2. **Details of the case study**

RESULTS AND DISCUSSION

Greater sustainability and circularity in organizations require changes in the way value is generated and business is done (Pieroni et al., 2019). This can be achieved by analyzing and understanding the human factor and the resources available for influencing the collective behavior of stakeholders that is required for achieving new organizational goals (Maitlis & Lawrence, 2007). Studying cultural issues when aiming at organizational paradigm shifts is important, because culture has a powerful function to perform in shaping human evolution (Boehm, 2008), and engagement with the CE and sustainability are affected by cultural dimensions (Morais, Pinto, & Cruz-Jesus, 2021).

Assessment of the OC usually focuses on organizational values (Linnenluecke & Griffiths, 2010), as they play an important role in organizations by influencing organizational structure, identity, and strategy (Gorenak & Kosir, 2012), and affecting business performance (Malbasic & Posarie, 2017). The main finding of this study, therefore, was the identification of those organizational values that support the transition towards the CE. These values are related to the future state of a circular company, that is, they are essential for supporting a circular organizational culture.

Generally speaking, in order to ensure its survival in the market every organization cultivates its own basic/core values, such as motivation, respect, integrity, excellence, and prosperity. Organizations that already have an innovative side cultivate values such as

ambition, creativity, agility, proactivity, flexibility, and audacity, which stimulate motivation and inspiration in individuals for facing up to challenges, seeking new opportunities, and taking risks. In addition to these values are those that are relevant for sustaining and leveraging a CE-oriented OC, which are defined as circular organizational values. In this sense, organizations seeking to implement a CE should nurture, share and communicate to their entire business ecosystem a set of values that suits their corporate environment. Exhibit 1 shows the proposed circular organizational values and their definitions.

Exhibit 1. **Circular organizational values**

Organizational Value	**Definition**
Adaptability	The ability or willingness to change to suit different conditions.
Availability	The quality or condition of someone who is open to influences or ideas.
Awareness	Internalizing the importance of inclusion and respect for ethical values, preservation, sustainable development, and the quality of life.
Collaboration	Working with other people or organizations to create or achieve something in common.
Commitment	The state or quality of being dedicated to a cause or activity. A strong motivation to make efforts to achieve the organization's goals and values.
Communication	Two-way process of reaching mutual understanding, in which participants not only exchange information, news, ideas and feelings, but also create and share meaning.
Concern	Paying attention to implement mechanisms that stimulate production, consumption, and sustainable development.
Continuous improvement	The desire to make the results better, more efficient and more effective.

Diversity	Feature of a mixed workforce that provides a wide range of abilities, experience, knowledge, and strengths.
Effectiveness	Achieving the desired results in the best way possible, so that the organization uses its resources intelligently and rationally.
Engagement with business ecosystems	The openness to participate in business ecosystems and associate with various types of companies, aiming to create a constantly evolving relationship in which each entity is flexible and adaptable in order to survive.
Ethics	The set of beliefs about what is morally right and wrong. The fundamental assumption of human behavior under which natural resource management decisions should be aimed at present consumption, without prejudice to future generations.
Future-oriented	Planning ahead before acting. Having a long-term view.
Humanitarian	An individual who desires the good of humanity. Being involved in, or linked to improving people's lives and reducing suffering.
Impact	The powerful effect or influence that something has on a situation, person, organization, society, or the environment. Positive impact in different areas (economic, social, and environmental).
Innovation	Creating and implementing new ideas that can be applied in products/services, processes, business models and value chains.
Longevity	The durability of something. Extending product life.
Openness	The ability to listen to comments, feedback, concerns, and new ideas, receive criticism, and engage in dialogue.
Proximity	Investing in a positive relationship with the different stakeholders of the organization.
Resilience	The ability to return to its original state after being disturbed.

Responsibility	Accepting responsibility for one's actions, admitting mistakes and learning from them. Considering the interests of society, assuming the impact of one's activities on customers, suppliers, employees, shareholders, communities, and other stakeholders, as well as on the environment.
Sharing	Sharing relevant information, ideas, suggestions and experiences with suppliers, research institutions, technology centers, universities, users, society, and other organizations.
Sustainability	Meeting present needs without compromising the ability of future generations to meet their own needs. Providing economic, social and environmental benefits simultaneously.
Synergy	The potential ability of individual organizations or groups to be more successful or productive as a result of cohesion and mutual efforts around a common goal.
Systemic innovation	An interconnected set of innovations, where each influences the other, with innovation both in parts of the system and in the ways in which they interconnect.
Systemic thinking	Understanding the interdependent relationships between the various components that make up the organization, as well as the environment with which they interact.
Transparency	A situation in which activities are conducted openly, without secrets, so that people can trust that they are fair and honest.
Waste reduction	Minimizing waste at source to reduce the amount needed to be treated and disposed of, which is usually achieved by better product design and/or process management.
Welcoming	Something or someone that invites or attracts by its characteristics.

Here we perceive that following the application of the confirmatory survey, the values, for which there was almost a consensus in terms of answers (>60%) at the highest levels of importance for the CE that we established in this study, were those that are most

related to circular principles and to sustainability (including the SDGs), such as: collaboration, commitment, engagement in business ecosystems, ethics, future-oriented, innovation, sustainability, systemic thinking, and waste reduction. When discussing the CE, it is noticeable that much is said about sustainability, because sustainable production and consumption are central to the CE (Patil, Seal, & Ramakrishna, 2020).

There is a direct relationship between circularity and sustainable development because of the desire to benefit present and future generations by simultaneously creating environmental quality, economic prosperity, and social equality (Saidani, Yannou, Leroy, Cluzel, & Kendall, 2019). In order for organizations to become more sustainable, their sustainability activities need to fit in with the desired OC and be considered authentic across the business ecosystem. In this sense, the values identified here can drive the CE and consequently be a lever for sustainable development in organizations.

According to Salvioni and Almici (2020), a drastic change in values is needed to develop specific awareness of socio-environmental responsibility. These values should be shared among all stakeholders to inspire good practices, behaviors, and mindsets that are aligned with different SDGs. Rodriguez-Anton et al. (2019) stated that CE initiatives form strong relationships and have synergies with different SDGs, especially with SDG6 (Clean Water and Sanitation), SDG7 (Affordable and Clean Energy), SDG8 (Decent Work and Economic Growth), SDG9 (Industry, Innovation, and Infrastructure), SDG11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), SDG13 (Climate Action), SDG14 (Life Below Water), and SDG15 (Life on Land). The CE is a tool that can be used globally and by different stakeholders to help achieve different SDGs. The circular organizational values identified in this study can also be great instruments for inspiring and engaging stakeholders to strive for common goals.

In this case study we also notice that in order to support the maintenance of a circular OC, Alpha emphasized sustainability as a core value. Kirchherr et al. (2018) stressed this idea and stated that the CE offers an innovative pathway to sustainable development, enabling the development of a modern, competitive, and at the same time, more sustainable economy (Rodriguez-Anton, Rubio-Andrada, Celemín-Pedroche, & Alonso-Almeida, 2019). Alpha nurtures reputation, loyalty, and transparency as values that guarantee the credibility of its products, services, and people with its stakeholders. Leadership, quality, health, and

security are values expressed by people in the organization. Values like innovation and creativity are not so well disseminated, since the company is still very traditional, and it should make an effort to better integrate those values into its culture since they are essential for sustaining a circular OC. In addition to these values, the company should also strengthen other values, such as openness, collaboration, proximity, and humanitarianism for alignment with a circular OC.

The perpetuation of behaviors, beliefs, and principles that are favorable to circularity and sustainability requires that the values that have been identified in this paper and that focus on responsible production and consumption should be spread throughout the whole business ecosystem. These values are: the willingness and motivation to protect ecosystems and communities; the promotion of reuse, recycling, refurbishing and sharing of products and services to eliminate waste; an orientation towards long-term value creation in an innovative, flexible, resilient, and systemic way; the establishment of inclusion and engagement practices among stakeholders; and open, clear and transparent dialogue. Besides fostering circularity these values, have a strong relationship and synergy with sustainable development, especially from the 2030 Agenda perspective.

To form a long-lasting OC these values must be well communicated and shared throughout the business ecosystem, especially by strong leaders who disseminate those values that are socially and environmentally responsible (Hoffman, 1993). Alpha emphasized that its leaders have a fundamental role to play in demonstrating that the CE is not just on paper, but is a proposal for changing the culture by defining goals, resources and internal strategies. The company's top management must transmit the company's values to the employees, who, in turn, should pass them on in behaviors in the workplace and social environment, and to other stakeholders. Shared attitudes and beliefs are practiced on a daily basis and are habitually inspired through training.

Alpha has various behaviors that are aligned with its shared values. For example, the company encourages team engagement and motivation for developing solutions in the CE and sustainability fields. It arranges periodic meetings to present and evaluate issues to do with the development of CE projects. It trains everyone in the company in the basics of sustainability, and communicates all the projects and investments it is developing in a transparent way. Once there is alignment throughout the business ecosystem, the values of

the circular organization are intended to inspire employees with creativity, motivation and empowerment for implementing circular and sustainable initiatives, and achieving the desired goals (Gorenak & Kosir, 2012).

The company also knows that there are beliefs that need to be strengthened in order to stimulate these behaviors, such as: "As a team, we're stronger than my individual opinion"; "If I work through the customer experience, I can generate work that is more interesting for my employees as well"; "I believe that employees can own their roles, and, regardless of any hierarchy, can make their contributions". Alpha also promotes the continuous improvement and excellence of its products and its people in order to be on the same level as its competitors, at least. As with any organizational change process, however, gaps are identified in the skills and resources that are needed.

Organizations generally need to look beyond its walls to create a viable business that has a positive impact on the whole ecosystem. Organizational values affect not only the internal work environment, but can also have an impact on the global values' system of individuals outside the work environment (Cambra-Fierro, Polo-Redondo & Wilson, 2008; Gond & Herrbach, 2006; Vitell & Ramos-Hidalgo, 2006).

The pressure for a more sustainable business is increasing and consideration of organizational values can help build a resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation, in accordance with SDG9. Circular practices, initiatives, mindsets, and behaviors are essential for promoting sustainable industrialization and an inclusive economy, particularly considering industrial symbiosis, remanufacturing and closed-loop supply chains (Kruchten & Eijk, 2020), which can evolve from the circular and sustainable organizational values that balance the "triple bottom line" (planet-people-profit), such as those presented in this paper.

The alignment of organizational values throughout the business ecosystem can enable a trajectory towards a CE and sustainability, thus generating positive externalities (Cambra-Fierro et al., 2008). As stated by Crane (1995), strong sustainability and a CE-oriented culture require consensus among individuals and organizations with regard to environmental values. Culture is created by way of time, values, attitudes and materialized issues, and can be both powerful and subtle enough to make the entire business ecosystem rethink its role in

sustainable development. When it comes to the CE and sustainability, the involvement of the entire business ecosystem is vital for the smooth running and effectiveness of the business.

CONCLUSION

This paper identified and analyzed different organizational values that can help organizations in their journey towards a CE. Although understanding the criteria related to the OC is vital for sustaining and incorporating organizational changes and transformations, there are still limitations in the literature with regard to the specific characteristics of circularity.

Throughout the study, we observed that circular organizational values are essential for supporting an enduring OC in the transition to a CE, and for leveraging sustainable development. Organizational values are key elements for guiding organizational change, because they influence behaviors and build organizational identity. Values must be periodically reviewed in order to align them with the desired OC. Strong support from top management is also essential for disseminating a circular culture throughout the organization and its business ecosystem.

To promote sustainable industrialization and an inclusive economy, organizations should analyze, understand and identify those organizational values that are aligned with the desired OC. The circular organizational values identified in this study support the achievement of different SDGs because they encourage a motivating and innovative work environment and have great potential for encouraging sustainable attitudes. Organizations, therefore, should make every effort to create, change, and/or adapt a culture that supports a CE and sustainability.

The exploratory and theoretical characteristic of this study could be seen as a limitation, so we suggest that future research should focus on more practical and propositional research based on multiple case studies and more quantitative approaches. It should adopt a more systemic approach to bringing up the role of organizational values in the transition towards a CE from the ecosystem perspective and considering individual and collective aspects. This will help analyze the role and significance level of each circular organizational value identified by the study in its transition towards a CE. There are also uncertainties and differences with regard to the assessment of the values required for a CE,

which makes clear the need for further studies in the area. Doubts about the terms and a lack of clarity with regard to the relationship between organizational values and the CE still exist, as does the importance of organizational values as instruments for guiding change. This relationship should be fostered in order to enable innovation and motivate the stakeholders to strive to achieve common goals.

Authors' Contribution

LUISA LAVAGNINI BARBOZA and ANA CAROLINA BERTASSINI worked on the conceptualization and theoretical-methodological approach. The theoretical review was conducted by LUISA LAVAGNINI BARBOZA. Data collection was coordinated by LUISA LAVAGNINI BARBOZA and ANA CAROLINA BERTASSINI. Data analysis included by LUISA LAVAGNINI BARBOSA. All authors worked together in the writing and final revision of the manuscript was coordinated by ALDO ROBERTO OMETTO and MATEUS CECILIO GEROLAMO.

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APPENDIX F – PAPER 6

Barboza, L.L, Bertassini, A.C., Gerolamo, M. C., & Ometto, A.R. (2020/2021). Economia Circular e Sustentabilidade: identificação de valores organizationais. GCV 2020-2021.

Economia Circular e Sustentabilidade: Identificação de valores organizacionais

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Resumo

O conceito de Economia Circular (EC) se destaca como um caminho viável para auxiliar no alcance da sustentabilidade. Para que a jornada de transição para a EC seja efetiva são necessárias mudanças não somente técnicas (produtos, processos e modelos de negócio), mas também o aprofundamento e o entendimento de critérios relacionados à Cultura Organizacional (CO). Dentre os fatores que possuem grande influência na CO estão os valores nos quais a organização está enraizada, e que instigam a percepção de um indivíduo perante a empresa, bem como seu comportamento. Contudo, há uma deficiência na literatura de características específicas de CO que impulsionem a transição para a EC. Desta forma, o objetivo deste artigo é fazer um levantamento teórico para identificar e analisar valores organizacionais essenciais para a sustentação de uma cultura que incorpore princípios e características de circularidade. A identificação dos valores organizacionais que dão suporte a EC se mostrou como de grande valia para viabilizar mudanças em organizações com base

no alinhamento de valores entre stakeholders de todo o ecossistema de negócio, além de contribuir para o desenvolvimento sustentável.

Palavras-chave: Economia Circular, Cultura Organizacional, Valores Organizacionais, Sustentabilidade.

Introdução

De acordo com a Organização das Nações Unidas (ONU) (2019), é previsto que nos próximos 30 anos a população mundial cresça em 2 bilhões de pessoas. Em um cenário em que a demanda por recursos supera a oferta, existem diferentes adversidades associadas, tal como o aumento da pobreza, da fome e a dificuldade de acesso à água potável e ao saneamento (Weetman, 2019). Estima-se, conforme a Avaliação Ecossistêmica do Milênio (2005), que nos últimos 50 anos foram degradados cerca de 60% dos ecossistemas da Terra. Segundo Gill e Benatar (2019), a poluição ambiental ainda é a principal fonte de danos à saúde do planeta, à vida humana, à equidade e à sustentabilidade econômica. Soluções que mitiguem tais danos devem ser sistêmicas com o objetivo de gerar benefícios e impactos positivos para todo o ecossistema de negócios.

Tendo em vista que o modelo econômico linear vigente resulta em inúmeros problemas ambientais, sociais e econômicos, mudanças são fundamentais visando reduzir os impactos negativos. Para que seja possível conciliar desenvolvimento econômico com a sustentabilidade, faz-se necessária a transição para um modelo econômico baseado no compartilhamento de valores e visão de longo prazo (CNI, 2018) que assegure maior efetividade na utilização e gestão de recursos, qualidade ambiental e bem-estar das populações (COTEC, 2016). Yang, Vladimirova e Evans (2017) afirmam que considerar a sustentabilidade no processo de inovação de modelos de negócios pode proporcionar formas inteiramente novas de criar e capturar valor.

Uma alternativa para superar as adversidades oriundas do modelo linear é a transição para a EC, a qual busca redefinir o conceito de crescimento econômico com foco na geração de benefícios para toda a sociedade ao ampliar a cadeia de valor para abranger todo o ciclo de vida do produto (Weetman, 2019). A EC abrange novos fluxos de materiais e produtos, e opera em diferentes níveis (micro, meso e macro) (Kirchherr, Reike, Hekkert, 2017). Ademais, estudos indicam que o conceito de EC possui relação direta com o desenvolvimento

sustentável, já que proporciona uma integração e coordenação equilibrada entre aspectos econômicos, ambientais, tecnológicos e sociais (Ghisellini et al., 2016; Murray, Skene, Haynes, 2017; Rathinamoorthy, 2019).

Modelos de Negócios Circulares (MNC) abrangem as principais atividades necessárias para a transição para a EC, visando a eliminação/minimização de impactos ambientais negativos resultantes da extração, do uso e do descarte de recursos e materiais (OECD, 2019). Além de implementar estratégias circulares para estender a vida útil dos produtos e fechar ciclos de materiais (Nußholz, 2018), um MNC inclui outras formas de otimização de valor para uma gama mais ampla de stakeholders (Bocken et al., 2016). Sendo assim, pode-se criar uma vantagem competitiva ao valorizar o cliente e, ao mesmo tempo, contribuir para o desenvolvimento sustentável da organização e da sociedade (Lüdeke-Freund, 2010). Para isso, deve-se perpetuar valores, mentalidades, comportamentos e atitudes que guiem o desenvolvimento dos consumidores, dos funcionários, dos parceiros, dos líderes e da empresa como um todo para um negócio com foco sistêmico (SITRA, 2018).

Um dos elementos-chave da transição para a EC é a mudança de mentalidades comportamental e organizacional (Dufva et al., 2016), refletida nos valores que compõem uma cultura. Sendo assim, o alinhamento entre os valores organizacionais que perpetuam na CO e os princípios circulares é essencial para criar um ambiente propenso ao desenvolvimento da EC.

A CO engloba elementos dos costumes de uma empresa e a forma a partir da qual a empresa transmite um senso de identidade e determina, por meio de rituais, crenças, significados, valores, normas e linguagens, como os negócios são feitos (O'Donnell, Boyle, 2008). Salienta-se que não existe apenas um tipo de CO; contudo, é de importância a identificação de fatores que busquem um consenso relativo a ações que beneficiem e respeitem a todos (Hofstede, 1991) para um adequado gerenciamento da empresa.

Os valores organizacionais constituem o "coração da cultura de uma organização" (Posner, 2010), envolvendo elementos que foram construídos ao decorrer do desenvolvimento da empresa como parte de seu processo de adaptação interna e externa (Fleury, 2009). No intuito de reduzir as resistências em seguir os ideais escolhidos pela organização, enfatiza-se a relevância da correlação entre os valores organizacionais e os valores de cada indivíduo

(Barrett, 2006). De maneira geral, os valores organizacionais são a base para integrar desempenho essencial e requisitos operacionais a uma estrutura orientada para resultados (Lagrosen, Lagrosen, 2019) e, portanto, devem ser claramente comunicados e compartilhados (Pires, 2004).

Sendo os valores elementos que orientam o desenvolvimento da Missão e da Visão de uma organização, e fornecem sustentação para a tomada de decisão (De Oliveira, 2009), estes podem ser vistos como instrumentos norteadores de mudanças e de comprometimento entre os stakeholders (Machado, 2009). Desta forma, instiga-se a influência dos valores organizacionais como instrumentos que também auxiliam na transição para a EC e sustentabilidade.

O objetivo deste artigo é identificar e analisar valores organizacionais essenciais para a sustentação de uma CO que incorpore princípios e características de circularidade e sustentabilidade, fornecendo uma contribuição teórica relacionada ao assunto para a área.

Metodologia

A metodologia deste estudo segue as diretrizes do método de análise de conteúdo. Segundo Krippendorff (2004), a análise de conteúdo torna inferências retiradas de textos replicáveis e válidas para um determinado contexto que está sendo estudado. Neste artigo, o foco da análise de conteúdo é qualitativo (análise de determinadas categorias analíticas), seguindo as três etapas propostas por Bardin (2011):

1. Pré-análise: Seleção dos documentos a partir de uma revisão bibliográfica conduzida nas bases de dados Web of Science e Scopus, e em relatórios e sites institucionais de empresas. Inicialmente, foram identificados 147 valores organizacionais relacionados ao conceito de EC. Não foram encontrados estudos que traziam explicitamente a relação entre as palavras-chaves “Circular Economy” AND “Organizational Values”. Portanto, buscas foram feitas individualmente para cada um dos 147 valores, combinando cada valor com o termo “Circular Economy”. Desta forma, foram obtidas informações quanto ao número de publicações por ano relacionado a cada valor organizacional, permitindo avaliar a recorrência de cada valor organizacional relacionado à EC em artigos e pesquisas científicas. Além disso, também foram feitas análises envolvendo os conceitos de “Circular Economy” e “Sustainability” nas bases de dados.

2. Exploração do material: Codificação e agregação dos dados com o auxílio do software NVivo. O NVivo realiza análises qualitativas de textos, facilitando a organização dos dados textuais, e a análise de palavras, frases e/ou parágrafos.

3. Tratamento dos resultados: Discussão dos resultados observados para a área de pesquisa.

Resultados e Discussão

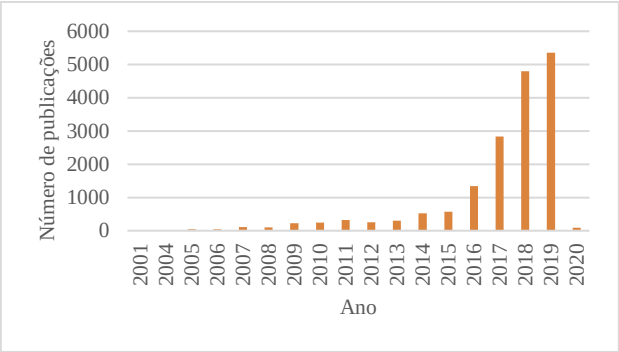
Como apresentado na Tabela 1, pôde-se perceber que, apesar do alto número de publicações envolvendo a EC, quando se busca por estudos que integrem, explicitamente, os conceitos de "Circular Economy" e "Organizational Values", nada é encontrado. Por outro lado, quando são relacionados individualmente cada valor identificado com o conceito de EC, muitos resultados são obtidos.

Tabela 1: Informações quantitativas gerais do estudo

Elemento	Quantidade
Nº de valores organizacionais identificados	147
Nº de pesquisas encontradas nas bases de dados	17.171
Nº de publicações com "*Circular Economy*" como palavra-chave	10.462

A Figura 1 apresenta o número de publicações por ano de estudos que relacionam cada um dos valores organizacionais identificados com o conceito de EC - buscas feitas em 17/10/2019. Com base nos dados apresentados na Figura 1, pode-se afirmar que a temática de EC e sua relação com valores organizacionais é recente, mas está em expansão desde 2014.

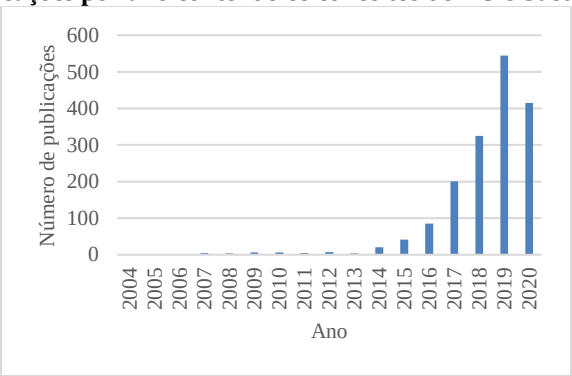
Figura 1: Número de publicações por ano contendo os conceitos de EC e cada valor organizacional identificado (17/10/2019)



Os dez valores organizacionais com maior número de publicações (com mais de 400 resultados) quando relacionados ao conceito de EC foram, em ordem decrescente: resultados; sustentabilidade; impacto; eficiência; desafio; foco no futuro; mudanças; performance; global; e inovação.

Além disso, percebeu-se que o número absoluto de publicações quando se busca individualmente o conceito de "Circular Economy" (6.780) é pequeno quando comparado com publicações com o conceito de "Sustentability" (223.266) – buscas feitas em 11/07/2020. Integrando ambos os conceitos, encontrou-se 1.673 publicações, sendo possível observar uma grande margem de melhoria em termos de desenvolvimento conceitual cruzado, principalmente também a partir de 2014, conforme ilustrado na Figura 2.

Figura 2: Número de publicações por ano contendo os conceitos de EC e Sustentabilidade (11/07/2020)



Com o auxílio do software NVivo, os 147 valores identificados foram analisados em termos de similaridade entre as suas definições (frases) e reduzidos a 89 valores, que foram agrupados em três grupos, sendo eles:

- Grupo 1: Valores relacionados ao processo de transição para a EC, ou seja, essenciais para a proposição de quaisquer tipos de mudanças e inovações (24 valores).
- Grupo 2: Valores relacionados ao estado futuro de uma empresa circular, ou seja, essenciais para a sustentação de uma CO circular (22 valores).
- Grupo 3: Valores que são básicos para quaisquer empresas, estejam elas almejando a EC ou não (43 valores).

O foco deste artigo é o estudo e a discussão dos valores organizacionais que dão suporte ao processo de transição para a EC (Grupo 1) e dos valores organizacionais que evidenciam o que deve ser nutrido em empresas que desejam ser circulares (Grupo 2). A seguir são apresentados cada valor com suas respectivas definições.

Grupo 1 – Valores gerais para mudanças e inovações

Abertura: estar aberto a se arriscar a novas ideias e tendências, e ao diálogo aberto com os stakeholders.

Adaptabilidade: habilidade; disposição; vontade e/ou inovação para mudar ou encaixar diferentes tarefas e características sociais e ambientais.

Agilidade: capacidade de responder a mudanças de forma rápida.

Amigável: comportamento afável das organizações em relação ao bem-estar dos funcionários, à comunidade, e ao meio ambiente.

Atenção aos detalhes: examinar meticulosamente cada elemento a fim de aperfeiçoar o processo produtivo e o produto/serviço de uma organização.

Audácia: opor-se aos padrões vigentes, trilhar com valentia e destemor caminhos desconhecidos.

Busca por melhoria contínua: tornar os resultados cada vez melhores e mais efetivos.

Comprometimento: motivação para direcionar esforços para alcançar os objetivos e valores da organização.

Comunicação: compartilhar informações e experiências abertamente com os stakeholders.

Criatividade: produzir ideias originais e incomuns, de forma a gerar um diferencial competitivo.

Desafio: estar dispostos a encarar riscos, estabelecer metas audaciosas e alianças, e aceitar a possibilidade de erros.

Empoderamento: promover e impulsionar grupos e comunidades na melhoria de suas condições de vida, aumentando sua autonomia.

Entusiasmo: impulso para buscar novas possibilidades, usar e criar novos conhecimentos, e produzir novos produtos/serviços e modelos de negócio.

Ética: pressuposto fundamental do comportamento humano sob o qual as decisões de gestão de recursos naturais devem ter como objetivo o consumo atual, sem prejuízo das gerações futuras (Mata, Cavalcanti, 2002).

Flexibilidade: habilidade de se adaptar facilmente a diferentes cenários e circunstâncias.

Iniciativa: capacidade de tomar decisões e realizar funções sem precisar que outros falem o que fazer.

Inovação: criar e implementar novas ideias para que possam ser aplicadas nos produtos/serviços, processos, modelos de negócio e na cadeia de valor.

Inspiração: senso de urgência e propósito que engaje os funcionários a participar da implementação da estratégia de uma organização.

Justiça: equidade na forma como os stakeholders são tratados.

Mudanças: oportunidade de encontrar novas formas de melhorar e de repensar os modelos de negócios e operacionais para oferecer um valor inovador.

Respeito: demonstrar consideração pelo outro independente das diferenças.

Responsabilidade: dever das organizações em cumprir a legislação e tomar iniciativas de forma voluntária para melhorar o bem-estar de seus funcionários, da comunidade local e da sociedade em geral, bem como a qualidade do meio ambiente.

Resultados: direcionar os esforços para o alcance de resultados positivos a longo prazo.

Segurança: condição, serviço ou produto isento de perigos quanto à agressão ao ser humano e ao meio ambiente, em conformidade com a legislação.

Grupo 2 – Valores organizacionais circulares

Colaboração: trabalhar em conjunto com stakeholders para criar valor, alcançar objetivos em comum, e viabilizar a sustentabilidade do sistema.

Compartilhamento: compartilhar informações, ideias, e recursos com os stakeholders.

Conscientização: internalizar a importância da inclusão e do respeito de valores éticos, da preservação do meio ambiente, do desenvolvimento sustentável e da garantia de uma adequada qualidade da vida.

Disponibilidade: garantir o fornecimento e uso de recursos ambientalmente amigáveis (renováveis, recicláveis, etc).

Diversidade: diferentes fontes de insumos, fornecedores, fontes de renda e força de trabalho.

Efetividade: utilizar os recursos de forma inteligente para alcançar os objetivos traçados.

Foco no futuro: planejar as ações de forma a antecipar as consequências futuras. Ter uma visão de longo prazo.

Global: organização com influência e dimensão global. Foco na geração global de impactos positivos.

Humanitário: desejar o bem da humanidade, estar ligado à melhoria da condição ambiental e social de um local e/ou de uma comunidade.

Influência: induzir/motivar/modificar o pensamento ou o comportamento dos stakeholders para que incluam os conceitos de EC.

Liderança: influência intencional exercida sob os demais stakeholders para direcionar a transição para a EC.

Longevidade: estender a vida útil de produtos, materiais e componentes.

Pensamento sistêmico: entendimento dos relacionamentos interdependentes entre os vários componentes que fazem parte da organização e do seu ecossistema de negócios.

Preocupação: percepção dos impactos negativos das atividades sobre o meio ambiente e a sociedade e atenção para a implementação de mecanismos que estimulem o desenvolvimento sustentável.

Proatividade: antecipar futuros problemas e/ou necessidades, de forma a mudar comportamentos e situações em busca de resultados efetivos de consumo e produção.

Proximidade: construção de relações e interações fortes entre os stakeholders, baseadas na confiança e no compartilhamento.

Redução de desperdícios: eliminação/minimização de resíduos na fonte para minimizar a quantidade necessária para ser tratada e descartada.

Resiliência: habilidade das organizações de se ajustarem às tendências do mercado e adotar modelos de negócio e estratégias de acordo com as mudanças contínuas.

Simplicidade: produto com layout simples, intuitivo e visual, tornando-o mais fácil de usar, compreensível e fácil de atualizar.

Sinergia: capacidade de organizações ou grupos individuais de serem mais bem-sucedidos ou produtivos como resultado do trabalho conjunto.

Sustentabilidade: proporcionar benefícios econômicos, sociais e ambientais simultaneamente, visando o bem-estar das gerações atual e futuras.

Transparência: situação em que as atividades são realizadas de maneira aberta, ganhando a credibilidade e confiança de serem justas e honestas.

De maneira geral, os valores organizacionais são relevantes por influenciarem a identidade, estrutura e estratégia organizacional (Gorenak, Kosir, 2012), além de serem o elemento central da CO (Tamayo, Mendes, Paz, 2000). Considerando-se mudanças corporativas, os valores devem ser modificados/alterados conforme a necessidade para estarem alinhados com a CO desejada. Para isso, estudos devem ser cuidadosamente realizados no intuito de verificar se os valores vigentes em uma organização são aqueles que apoiam a estratégia de negócios ou se devem ser feitas modificações na maneira como os valores são incorporados na prática (Hofstede, 1991).

Os valores definidos pelo Grupo 1 são a base para guiar e dar suporte a empresas que desejam iniciar sua jornada rumo à EC. Tais valores despertam nos indivíduos que irão conduzir essa jornada a motivação e inspiração para enfrentar desafios, buscar novas oportunidades e se arriscar em ambientes e cenários "desconhecidos". Os valores do Grupo 1 são imprescindíveis para que as organizações tenham a base sólida para desenvolver e nutrir os valores apresentados pelo Grupo 2, isto é, aqueles essenciais para sustentar e alavancar o desenvolvimento da EC. Os valores organizacionais circulares dão suporte a esse novo modelo econômico, e possuem o potencial de fomentar o desenvolvimento de uma CO voltada para inovações, incluindo o alinhamento com práticas circulares e sustentáveis. Esses valores devem ser efetiva e claramente comunicados e compartilhados para formar uma CO duradoura.

A circularidade pode ser vista como uma condição para impulsionar a sustentabilidade (Bakker et al, 2014; Galvão et al., 2018; Webster, 2015), conceito que tem se tornado cada vez mais vital considerando-se os impactos ambientais globais. Segundo Kiesnere e Baumgartner (2019), para que as empresas se tornem mais sustentáveis, além de serem necessárias inovações, suas atividades de sustentabilidade precisam se adequar à CO e serem consideradas autênticas em todo o ecossistema de negócios. Neste sentido, os valores identificados neste artigo podem impulsionar a EC e, consequente, ser uma alavanca para a sustentabilidade em organizações.

Conclusões

Como principal contribuição, este artigo levantou 89 valores organizacionais, dos quais 43 são básicos para a manutenção de qualquer negócio, 24 devem ser nutridos para a efetiva proposição de inovações e processos de transformação e mudança, e 22 que devem ser nutridos a fim de alavancar a transição para a EC em busca do desenvolvimento sustentável. O foco deste estudo foi para os valores relacionados aos dois últimos grupos.

A transição para a EC requerer alterações nos modelos de negócios para incluir a implementação de uma cadeia reversa de suprimentos, um maior grau de cooperação e integração entre os stakeholders, e inovações na proposta de valor para os clientes. Neste sentido, os valores organizacionais são elementos-chave para incorporar diretrizes de gestão e pensamento do ciclo de vida dentro das empresas. Eles explicitam os sentimentos

compartilhados nos quais a organização está enraizada, influenciam comportamentos, e constroem a identidade organizacional.

Considerando-se a importância do conceito de sustentabilidade como forma de integrar os âmbitos social, ambiental e econômico, e atenuar os impactos socioambientais globais, destacou-se a sua relação com a EC, a qual já é vista por diferentes autores como uma forma de contribuir para o desenvolvimento sustentável. Neste sentido, os valores organizacionais destacados podem impulsionar, além da circularidade, um pensamento mais sustentável em organizações.

Todavia, por mais que os valores organizacionais se caracterizem como instrumentos norteadores de mudanças, vale salientar que ainda há uma deficiência na literatura de características específicas de CO que impulsionem a transição para a EC. Por isso, é importante a continuidade em pesquisas nesta área, visando reduzir as resistências e facilitar a incorporação de inovações e mudanças corporativas com foco em circularidade e sustentabilidade.

Agradecimentos

Agradecemos ao Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) por meio do Edital PIBIC 2019/2020 (processo 117839/2019-1); à Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES – 001); e à Escola de Engenharia de São Carlos (EESC/USP).

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APPENDIX G – PAPER 7

Bertassini, A. C., Calache, L. D. D. R., Carpinetti, L. C. R., Ometto, A. R., & Gerolamo, M. C. (2022). CE-oriented culture readiness: an assessment approach based on maturity models and fuzzy set theories. Sustainable Production and Consumption, 31, 615-629.

Circular Economy oriented culture readiness: an assessment approach based on maturity models and fuzzy set theories

Abstract

Moving towards a Circular Economy (CE) requires systemic changes across organizations, technological and cultural changes. However, there is a lack of studies in the literature on guidelines and tools specifically focused on helping organizations to identify the aspects that could be improved to implement a CE-oriented culture. Thus, this paper aims to propose a fuzzy logic-based approach to assess the readiness of organizations to implement a CE-oriented culture. An in-depth literature review to identify the CE-oriented culture elements, a fuzzy Delphi methodology (FDM) to select the elements, a fuzzy inference system (FIS) to classify the organization in readiness levels, and an application to clarify the proposed approach were carried out. The main result of this study is an assessment approach that, based on analyzing a set of elements representing a CE-oriented culture: classifies an organization in six levels of readiness to implement a CE-oriented culture; provides a pairwise comparison of the performance of the organization between the building blocks; and a radar chart with the overall performance of the organization regarding CE-oriented culture. These three outcomes provide organizations with specific information and guidance for decision-making regarding the changes that should be made to adapt or change the existing culture to one that comprises the specificities of CE. This study found that organizations that focus on radical innovations and balance the efforts between technical and soft aspects are more oriented towards a CE culture. It was also identified that making a more in-depth analysis of the presence of CE-oriented culture elements in the organization may contribute by mitigating possible rebound effects that could be generated from implementing CE practices. Moreover, analyzing the culture orientation for CE of the organization might create in leaders and

employees a sense of urgency to move towards CE as a way to obtain environmental, social and economic benefits.

Keywords: Circular Economy, Sustainability, Organizational Culture, Maturity Model, Readiness, Fuzzy Sets.

Nomenclature

AG: Aggregation operator

BMI: Business Model Innovation

CE: Circular Economy

CM: Centroid Method defuzzification technique

CMM: Capability Maturity Model

Eq: Equation

FDM: Fuzzy Delphi Methodology

FIS: Fuzzy Inference System

FST: Fuzzy Set Theory

MM: Maturity Models

n: Number of discrete points of the fuzzy set

OC: Organizational Culture

R: Implication operator to define the relationship between the input fuzzy numbers and the consequents

S: Fuzzy singleton used in the composition operation to obtain the output fuzzy number

SDGs: Sustainable Development Goals

SEI: Software Engineering Institute

$\mu_{\tilde{A}}(x)$; $\mu_{\tilde{B}}(x)$: Membership function that associates the element x to a real value $\in [0,1]$ to represent the membership degree of x in the fuzzy sets $\tilde{A}$ and $\tilde{B}$

x_k: Discrete point of the fuzzy set

1. Introduction

A fundamental shift in the purpose of business is currently occurring towards the transition to a sustainable society and business ecosystem. Circular Economy (CE) is a systemic model that can mitigate chronic problems caused by human economic activities and could be a way to accomplish the Sustainable Development Goals (SDGs) (Schroeder et al., 2018; Kristoffersen et al., 2021), depending on the business strategy. CE promotes a vision that decouples the consumption of non-renewable resources from value creation (EMF, 2014) contributing to organizations dealing with business challenges (e.g., global competition, environmental awareness, limited resources) (Upadhyay, Laing, et al., 2021). CE is rooted in paradigms of waste minimization (Barón et al., 2020) and efficient use of resources (Ghisellini et al., 2016) mostly focused on the environmental and economic side of Sustainable Development (SD). However, CE is also a tool to address existing social needs. This is achieved by empowering workers, enabling social inclusion, and fostering sustainable lifestyles (e.g., applying practices and policies for long-lasting human-centered design) (Geissdoerfer et al., 2017).

CE is usually implemented through Business Model Innovation (BMI). BMI is considered a source of transformation within sociotechnical transitions (Sarasini; Langeland, 2021), representing the micro-foundation of the transition towards CE. The research area of transition towards more sustainable and circular societies is increasing in the literature (van Mossel et al., 2018; Kern, Sharp, Hachmann, 2020; Hacker; Binz, 2021), however, transition aspects inherent in the internal context of organizations and people involved are not considered.

To be able to achieve ambitious targets regarding CE, companies are radically transforming their business models and strategic orientation. However, to support these disruptive changes and successfully implement business strategies and BMI oriented to CE, companies need to realign their organizational culture (OC) as OC is the key to solidifying changes that need to be implemented (Sawe et al., 2021). Some previous studies highlighted the need to study the implications of OC in the CE transition (Bertassini et al., 2021; Korhonen et al., 2018), but they did not discuss the complexity of such aspects. OC is complex and consists of different variables that should be well understood and developed to support the CE transition. These

variables are reflected by different people's judgement and are usually intangible and subjective.

Fuzzy logic has the potential to deal with intangible and subjective variables, complex and uncertain problems, and the potential to deal with judgment from different people. Thus, this seems to be a suitable concept to deal with the complexity and subjectivity attached to OC.

Furthermore, a challenge in the transition to CE and changes in OC requires a broad view of the company's evolution, which makes Maturity Models (MMs) suitable. MM aim to guide organizations to assess and track their progress and/or readiness in a certain initiative or domain (Asdecker; Felch, 2018).

In the literature, there is a lack of documented studies regarding the use of MM or similar concepts applied in the CE context. MATChE is a tool to support companies in their transition to circularity. Its development was supported by the Danish Industry Foundation and carried out by the Technical University of Denmark (DTU) in partnership with Rambøll and Viegand & Maagøe consultancies. The tool aims to obtain a 'readiness profile' based on evaluating a set of skills and experience levels of different organizations considering eight different areas: organization; strategy & business model innovation; product & service innovation; takeback & end-of-life strategies; use, support & maintenance; technology & data; manufacturing & value chain; and policy & market. This is a robust tool to understand how CE acts in different areas of an organization. However, OC aspects are superficially addressed. Standard BS 8001:2017 (The British Standard Institution, 2017) proposes a maturity level to guide organizations in the transition process by implementing CE principles. The standard addresses a culture of learning and innovation in some of its parts but it does not propose specific aspects that characterize a CE culture or actions that should be taken in the OC sense to foster the transition towards CE. Sehnem et al., (2019) propose an MM used to leverage and measure the implementation of CE in the wine production chain in Brazil but it is focused just on technical aspects of the production processes and its circularity. Other similar studies use MMs for sustainability implementation, but they are applied in specific areas, such as the sustainable supply chain (Salvadó et al., 2018; Okongwu et al., 2013; Chalmeta, Barqueros-Munoz, 2021); industry 4.0 (Benešova et al., 2021; Vásquez et al.,

2021; Caiado et al., 2021); innovation (Baumgartner & Ebner, 2010) or strategy (Sari et al., 2020; Hynds et al., 2015).

To the best of the authors' knowledge, none of the previously studied models addresses OC cultural aspects for CE implementation. Moreover, most of the existing MMs applied to 'green contexts' lack a self-assessment tool to support decision-makers in assessing the readiness and/or maturity of fragmented building blocks and elements. Most models do not address CE-oriented culture requirements: do not have a well-defined structure with elements; do not consider the organizations' interests to define improvement actions; do not address the inherent uncertainty brought by intangible aspects of human judgment, and imprecision.

The limitations and weaknesses of previous studies are understood as a research opportunity when combined with the gap identified by Bertassini et al., (2021a) that pointed out the need for the proposal of quantitative methods and tools that support strategic decision-making focused on CE-oriented culture as a way of establishing overarching targets for business outcomes. Thus, this paper aims to propose a hybrid approach based on MMs, Fuzzy Delphi Methodology (FDM), and Fuzzy Inference System (FIS) to evaluate the readiness of organizations to move towards a sustainable CE-oriented culture. The term "readiness" was preferred to address organizations' needs for building a CE-oriented culture, rather than the maturity level of a specific element or building block (see Section 2.2, Maturity Model to understand the difference between them). Moreover, there is a huge variety of techniques, methods, and concepts that could be used to design this kind of tool, but in this study, we address the gap identified by Bertassini et al (2021a) using fuzzy logic MM. The MM theory was chosen since it allows us to define levels to classify the organizations regarding their readiness to implement some concept. FMD is used to deal with consensus group decision-making in the selection of circular economy elements. FDM is adequate when it is desired to refine the criteria or elements based on the preference of a group of experts (Tseng et al., 2022). Fuzzy logic is suitable to be used to develop tools to assess the maturity of a company as it enables us to consider all the variables used in a problem (Caiado et al., 2021). It is a reliable and useful technique for measuring the level of CE-oriented culture through a readiness assessment approach.

To the best of the authors' knowledge, there is no previous study in the literature that presents an approach that combines MMs, fuzzy set theories, CE, and OC. Thus, this study brings a multidisciplinary theoretical contribution. Studies that combine concepts from different knowledge areas are important to deal with complex, new, and disruptive challenges. Moreover, it presents an adaptable methodology used to develop the approach that could inspire the solution of similar problems in different research areas. This tool is intended to be adaptable to remain applicable to any organization, irrespective of size, sector, location, and technology intensity. It helps managers to improve their journey towards CE as an organization scoring high in CE-oriented culture readiness suggests that strategy and culture are aligned to CE principles. The novelty of this paper lies in the integration of relevant topics from different areas that, when combined, create a powerful, usable, and modern approach to foster the transition towards a CE-oriented culture that has been understood as the key to achieving a sustainable society. Moreover, to the best of the authors' knowledge, it is the first time that decision-making techniques (FDM and FIS) are used to construct an MM that deals with subjective aspects as is the case of the OC oriented towards CE.

The remainder of the paper is structured as follows: Section 2 reviews the literature on relevant topics for this study. Section 3 presents the methods used for the development and testing approach. Section 4 presents the results. Section 5 presents the discussion of the results with a summary of theoretical and managerial contributions. Section 6 presents the main conclusions of the study.

2. Literature Review

This section gives an overview regarding the essential concepts for the development of this study: CE-oriented culture (Section 2.1.), maturity model theory (Section 2.2.), and fuzzy decision-making techniques (Section 2.3.).

2.1.Circular Economy oriented culture

The CE presents the idea of creating interconnected systems that can be sustained in the long term (Xavier et al., 2021) aiming to optimize the value of products materials, and components (EMF, 2014; Kirchherr et al., 2017). CE aims to create a closed-loop economy by embracing a loop system connecting economy-environment collaborations (Mathews & Tan, 2011). CE can be defined as a new approach to address sustainability, paying particular attention to the

social aspect (Upadhyay, Mukhuty, et al., 2021). The transition towards CE requires new mindsets (Dufva et al., 2016) that drive organizations to implement radical innovations based on an ecosystem perspective (Konietzko et al., 2020) seeking to deliver value for a diversity of stakeholders (Bertassini et al., 2021b). Creating the right culture is essential for organizations to successfully implement CE strategies.

The OC reflects the values, norms, rules, procedures, organizational goals (Jones, 2013), and the sense of identity shared between the employees (Cameron & Quinn, 2011). OC reflects what an organization is (Smircich, 1983) and has the power to foster or hinder innovations (Schein, 1984). An OC focused on CE is an organization where all members have common and shared values, mindsets, and beliefs about the importance of creating and delivering positive values for all the ecosystem stakeholders.

OC for the CE is recent in the literature and according to Bertassini et al. (2021a), a CE-oriented culture is represented by five building blocks namely mindsets, values, behaviors, capabilities, and competences, that are dynamically linked. Mindsets are rooted in values. Values are translated into behaviors. Behaviors are executed when combined with the right capabilities. Capabilities become competences when they are supported by attitudes. These building blocks represent the soft and hard aspects that are relevant for organizations to promote changes. According to Bertassini et al. (2021a):

Values are criteria, patterns, or directional principles that are related to the future state of a circular organization.

Mindsets are beliefs or mental attitudes aligned with CE principles and values that determine how the organization will interpret and respond to situations.

Behaviors describe how people and organizations act in the CE transition.

Capabilities describe the right theoretical knowledge on CE concepts (qualification) with the ability to perform these concepts (know how to do).

Competences describe the combination of the capabilities implemented repeatedly with the attitudes to implement these capabilities (know how to behave).

To evaluate if an organization has a CE-oriented culture and what elements characterize the circularity of a certain organization, a tool or model is required. OC is passive of evolutions

and transformation along time. On the other hand, organizations that are not thinking circular from the beginning need to pass through a journey to implement CE concepts. Thus, the MM theory seems to be a suitable theory to be used to propose a readiness assessment approach.

2.2.Maturity Model

In 1979, Crosby developed a maturity framework for quality management (Crosby, 1979), and the Software Engineering Institute (SEI) launched the well-known Capability Maturity Model (CMM) (Paulk, 1993). These two models leveraged the use of MM by many organizations of all domains, and a wide range of models was created for different fields.

MMs are used to support the evolution from an initial state to the desired state following a defined path (Röglinger et al., 2012). The term maturity can be defined as "the state of being perfect, complete and ready, or as a measure used to evaluate the resources of an organization" (Reis et al., 2017, p. 644). MMs are designed to assess the evolution of a selected domain based on a set of criteria in a sequence of levels and used to describe, explain and evaluate growth cycles (Król & Zdonek, 2020). MM can be created for three purposes: be descriptive, prescriptive, or comparative. A descriptive MM is used to assess the as-is situation of an organization and is proposed in the form of a diagnostic tool (Okongwu et al., 2013; Reis et al., 2017; Röglinger et al., 2012). A prescriptive MM is an improvement path to higher maturity levels that provide guidelines and measures to an organization (Okongwu et al., 2013; Reis et al., 2017; Röglinger et al., 2012). A comparative one permits an organization to benchmark capabilities externally and internally based on historical data collected from other organization assessments (Okongwu et al., 2013; Reis et al., 2017; Röglinger et al., 2012).

In this study, the MM is used with a descriptive purpose, that is, to create a readiness assessment approach to identify the level of readiness in a CE-oriented culture. 'Readiness' and 'maturity' are used in the literature to represent the same set of concepts (Pirola et al., 2019) however they have relevant differences. Readiness Assessments are diagnostic tools to analyze and determine the level of preparedness, attitudes, and resources at all levels of a system, aiming to clarify whether the organization is ready or not to start the development process (Akdil et al., 2017; Mittal et al., 2018). On the other hand, MMs are models that help

an organization to reach a more sophisticated maturity level in culture, processes, and/or technologies following a step-by-step continuous improvement process (Gökalp et al., 2017).

The implementation of MMs in organizations allows a better decision-making process, highlighting for managers and leaders their current maturity levels and indicating the paths that should be followed to improve in each domain. According to Caiado et al., (2021) and Röglinger et al., (2012), the MM theory should be used to develop ready-to-use instruments for evaluating and improving maturity, and that can adapt to the specific characteristics of the organization.

We analyzed the studies (see Table A in Section 1 of the supplementary material) existing in the literature that uses MM applied to 'green contexts', such as sustainability (Baumgartner & Ebner, 2010; Isaksson, 2019) and eco-design (Pigosso et al., 2013), and CE specifically (Sehnem et al., 2019). These models usually comprise 3 to 6 levels and most of them use 5 levels and are usually based on the CMM. Based on this analysis, the authors decided, as a development strategy, to consider heterogeneous and relevant contents from existing MMs in a new model structure by multiple dimensions. Thus, our approach proposes six levels in which an organization could be classified in its readiness to implement a CE-oriented culture. The levels, their nomenclature, and their descriptions are presented in Table 1.

Table 1: CE-oriented Culture Readiness Levels

Level		Description
0	**Rudimentary**	Circular strategies are not part of the organization's interests, they only follow the legislation. They do not express any value, mindsets, behavior, capability, or competence oriented to CE.
1	**Early Stages**	The organization has little experience or knowledge about circular business strategy. There are some actions related to CE, but environmental and social protection actions are seen as costs. There are a few values that are related to CE, but the current mindsets and behaviors are focused on economic gains.

2 Opportunist	The organization has some knowledge but lacks experience in CE. It believes that the implementation of circular strategies can create opportunities for cost reduction. It implements circular strategies focused on dealing with basic inefficiencies, and/or reaching some specific strategic goal. It shares in the mission and vision some values that are related to CE. It understands the need to implement circular strategies, but does not cultivate day-to-day behaviors that express this concern. It only develops specific projects on this thematic.
3 Integrated	It occasionally works with CE and has some knowledge and experience. It incorporates some circular principles in some of our products/services and processes. It captures some values regarding the implementation of circular strategies. CE strategies are formalized in documents and processes. The organization is engaged in the transition to a more circular economic model. It shares internal values that cultivate circular behaviors and mindsets.
4 Innovative	It frequently works with CE and has substantial knowledge and experience. It Incorporates CE principles in the innovation projects portfolio, including the development of new products, in the marketing of the brand, and in reports. The business model is circular and captures many circular values and even shares them with direct stakeholders. It engages with some groups that study and discuss CE. Most of the shared values are circular and cultivate day-to-day pro-circular behaviors and mindsets.
5 Leader	The organization has profound experience and in-depth practical knowledge. CE is in DNA and CE is the way to do business. It disseminates CE at the ecosystem level and brings together the stakeholders (direct and indirect). We are engaged in the proposition of public policies and legislation to foster the transition towards CE. It influences other organizations to engage in the transition journey. All shared values cultivate circular behaviors and mindsets. It seeks to improve circular performance measurement.

2.3.Fuzzy Decision-Making Techniques

Decision-making processes usually have to handle information resulting from imprecise and subjective judgments made by different decision-makers using linguistic variables. To deal with this type of information, the Fuzzy Set Theory (FST), proposed by Zadeh (1996), is widely applied in decision-making models (Kahraman et al., 2015). In FST, the linguistic variables are represented qualitatively using linguistic terms and quantitatively translated by fuzzy numbers in a discourse universe using pertinence functions (Abdullah, 2013). The triangular and trapezoidal membership functions (See Figure A and B and Equations (Eqs) 1 and 2 in Section 2 of the supplementary material) are commonly used to represent the fuzzy numbers (Pedrycz and Gomide, 2007).

The FST stands out due to its ability to be combined with different decision-making techniques to address data imprecision (Dubois and Prade, 2012). Several studies in the context of CE have been using the FST combined with techniques to solve different decision-making problems (Sassanelli et al., 2020). However, the selection of a fuzzy decision-making technique depends on the characteristics of the problem being analyzed and its objectives. For the present study, the Fuzzy Delphi methodology and the Fuzzy Inference System technique were applied in the proposed decision-making model.

2.3.1. Fuzzy Delphi Method

The Delphi Method was presented by Dalkey and Helmer (1963) and is an interactive consensus approach widely applied in many decision-making and prediction problems (Kannan, 2018). In the Delphi Method, a group of experts present their access to a given problem, and based on a feedback mechanism, the experts can modify their previous judgments to reach a consensus. However, the achievement of consensus through repetitive surveys can be difficult and time-consuming (Zhao and Li, 2015). Besides that, the traditional Delphi Method is not adequate to handle uncertainty and imprecise experts' judgments. Therefore, the FDM has been used to overcome the limitations of the traditional Delphi Method (Noori et al., 2019).

Initially proposed by Murry et al. (1985), the FDM has different operation approaches developed in several studies (Wang and Peng, 2020). A well-known method is presented by Ishikawa et al. (1993), which integrates the experts' judgments into fuzzy numbers (Hsu et al., 2017). Since its proposition, the FDM has been used in several decision-making models

for the elicitation of criteria, definition of performance indicators, and selection of decision-makers (Liu et al. 2020; Noori et al., 2019; Zhao and Li, 2015). For this study, the operations approach presented in Kanan (2018) is used in the FDM (See Section 3 in supplementary materials for more details about the mathematical step-by-step for the FDM application).

2.3.2. Fuzzy Inference System

The FIS is a non-linear approach widely used in decision-making models to model human reasoning through fuzzy if-then rules (Zanon et al., 2020). The main features of FIS are the ability to handle natural language using fuzzy linguistic variables, and it addresses non-linear relationships between inputs and outputs, making it an important tool for decision support systems and process control (Guillaume, 2001). The FIS proposed by Mamdani and Assilian (1975) is one of the most applied inference systems, in which the antecedent and consequence are defined as fuzzy sets, which are suitable for linguistic models (Pourjavad and Mayorga, 2019).

The Mamdani Inference method uses inference rules defined through experts' knowledge. The inference rule base is created using the logic connector "AND" to define the inference relation between the output and input fuzzy variables (Junior et al., 2013). To this end, the t-norm (minimum) operator, presented in Equation (Eq). 1 is usually applied because of the smaller computational effort required (Zanon et al., 2020).

$$\mu_{\tilde{A}}(x)\ AND\ \mu_{\tilde{B}}(x) = Min\{\mu_{\tilde{A}}(x), \mu_{\tilde{B}}(x)\} \qquad \text{Eq} \quad (1)$$

For each activated rule, the Minimum (Mamdani) implication operator is represented in Eq. 2 and is commonly used by the fuzzy inference structure to define the relation R between the fuzzy numbers obtained from the logic operations and the consequent $\tilde{B}$ (Osiro et al., 2014). Other options of implication operators that are frequently applied are the Max-Min (Zadeh) and the Multiplication (Larsen), presented respectively by Eqs. 3 and 4. (Pourjavad and Mayorga, 2019).

$$\mu_{R_{A\to B}}(x, y) = Min\{\mu_A(x), \mu_B(x)\} \qquad \text{Eq.} \quad (2)$$

$$\mu_{R_{A\to B}}(x, y) = Max\{1 - \mu_A(x), Min(\mu_A(x), \mu_B(x))\} \qquad \text{Eq.} \quad (3)$$

$$\mu_{R_{A\to B}}(x, y) = \{\mu_A(x)\ *\ \mu_B(x)\} \qquad \text{Eq.} \quad (4)$$

The operation called composition is used to obtain the output fuzzy number of each activated rule. Composition operations are carried out between a fuzzy singleton and the implication relations. The most commonly used composition operators are Max-Min, Max-Prod, and Max-Media, respectively given by Eqs. 5 to 7 (Junior et al., 2013; Osiro et al., 2014).

$$S \circ R(x,y) = Max\{Min(\mu_S(x,y), \mu_R(y,z))\} \quad \text{Eq. (5)}$$

$$S \cdot R(x,y) = Max\{\mu_S(x,y) * \mu_R(y,z)\} \quad \text{Eq. (6)}$$

$$S \oplus R = Max\left[\frac{1}{2}(\mu_S(x,y) + \mu_R(y,z))\right] \quad \text{Eq. (7)}$$

The last step of the inference process is the aggregation of the resulting composition operations for each activated rule (Pourjavad and Mayorga, 2019). Different aggregation operators can be used in this step, such as arithmetic, geometric or harmonic means, Min and Max. However, when it is desired the compensation between input variables, the Max operator shown in Eq. 8 should be applied (Zanon et al., 2020).

$$AG(.) = Max(\mu_{R_1}(x), \mu_{R_2}(x), \dots, \mu_{R_n}(x)) \quad \text{Eq. (8)}$$

The output fuzzy numbers resulting from the inference process are converted into a crisp number using a defuzzification technique. The Gravity Center or Centroid Method is the most used defuzzification technique because of its ability to consider all membership values in a given region, assuming a centralized position. Let n be the number of discrete points of the fuzzy set, and then the Centroid Method can be represented as in Eq. 9 (Martínez et al., 2020).

$$CM = \frac{\sum_{k=1}^{n} \mu_A(x_k) * x_k}{\sum_{k=1}^{n} \mu_A(x_k)} \quad \text{Eq. (9)}$$

After the defuzzification process, a classification procedure can be carried out considering all the individual contributions to each activated rule. The class to be provided as a response will be given by the linguistic term that produces the highest degree of activation concerning that defuzzified value (Osiro et al., 2014).

3. Methods

This study can be classified as quantitative axiomatic prescriptive model-based research as it proposes a quantitative model that analyzes the behavior of a system variable based on the

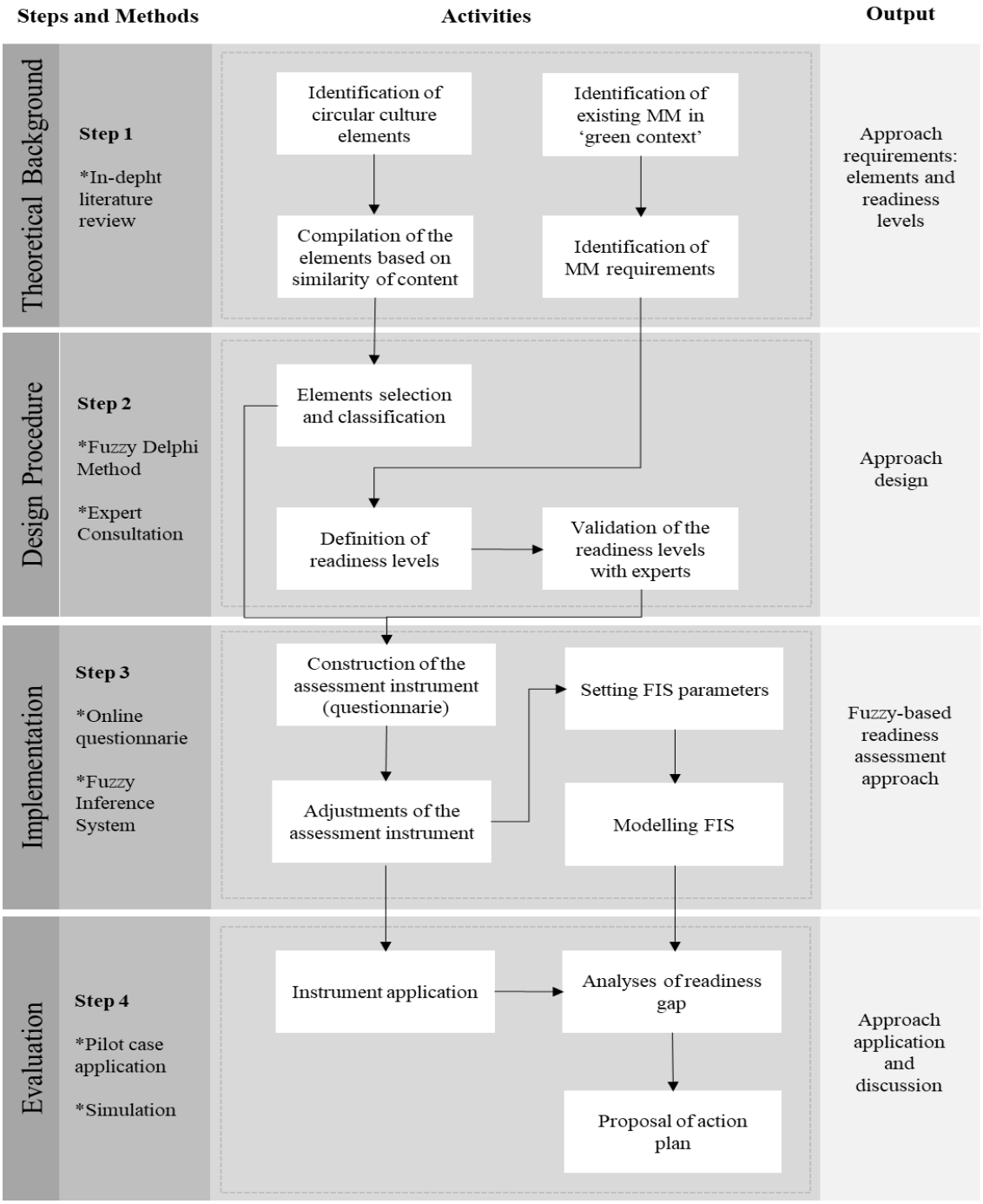
behavior of other variables (Bertrand & Fransoo, 2016). It is axiomatic as the research uses the theoretical foundation consolidated through a literature review to construct the questionnaire and to define the readiness levels. It is prescriptive since we combine the literature with fuzzy techniques to propose an approach to evaluate the readiness of organizations to move towards a sustainable CE-oriented culture. The proposed approach was constructed and applied based on the problem presented in the introduction following four steps as shown in Figure 1.

Step 1 – Theoretical background: consisted of a literature review to identify the elements that characterize a CE-oriented culture and a literature review to identify the existing MM or readiness tools applied to 'green context'. To identify the elements an exploratory review was conducted to increase the number of papers reached. 151 elements (see Table B in Section 4 of the supplementary material) were initially identified.

To identify the MM or the readiness tools, a keyword search of the article's title, abstract, and keywords was carried out in the Scopus and Web of Science databases. The search is limited to the string: *(((“maturity model” OR “readiness assessment”) AND (“sustainability” OR “circular economy” OR “closed-loop” OR “organizational culture”)))*. The studied articles went through a systematic review procedure: first, the title, abstract, and keywords were analyzed; then, the introduction and conclusion, and then the full paper. As inclusion criteria, we only selected articles that propose maturity levels or readiness assessments applied to 'green contexts' or that used fuzzy as a development methodology. In total, 19 articles were analyzed in-depth considering the number of levels, the description of each level, and the domains addressed by the MM. Based on the study of the existing MM, the authors decided, as a development strategy, to consider heterogeneous and relevant contents from existing MMs in a new model structured by multiple dimensions, linked with fuzzy logic. Thus, this first step was conceptual and derived the initial set of elements and the levels and characteristics that the readiness assessment approach should have.

Step 2 – Design procedure: in this step, the approach was designed. First, the initial set of elements was selected and classified using the FDM. Then, the number of readiness levels and description of each level were proposed and validated with experts.

Figure 1: Methodological steps



Step 3 – Implementation: this step comprises the construction of the assessment instrument (questionnaire) and the definition of the FIS functions and rules. The first draft of the questionnaire was built and discussed with CE experts resulting in some adjustments on the

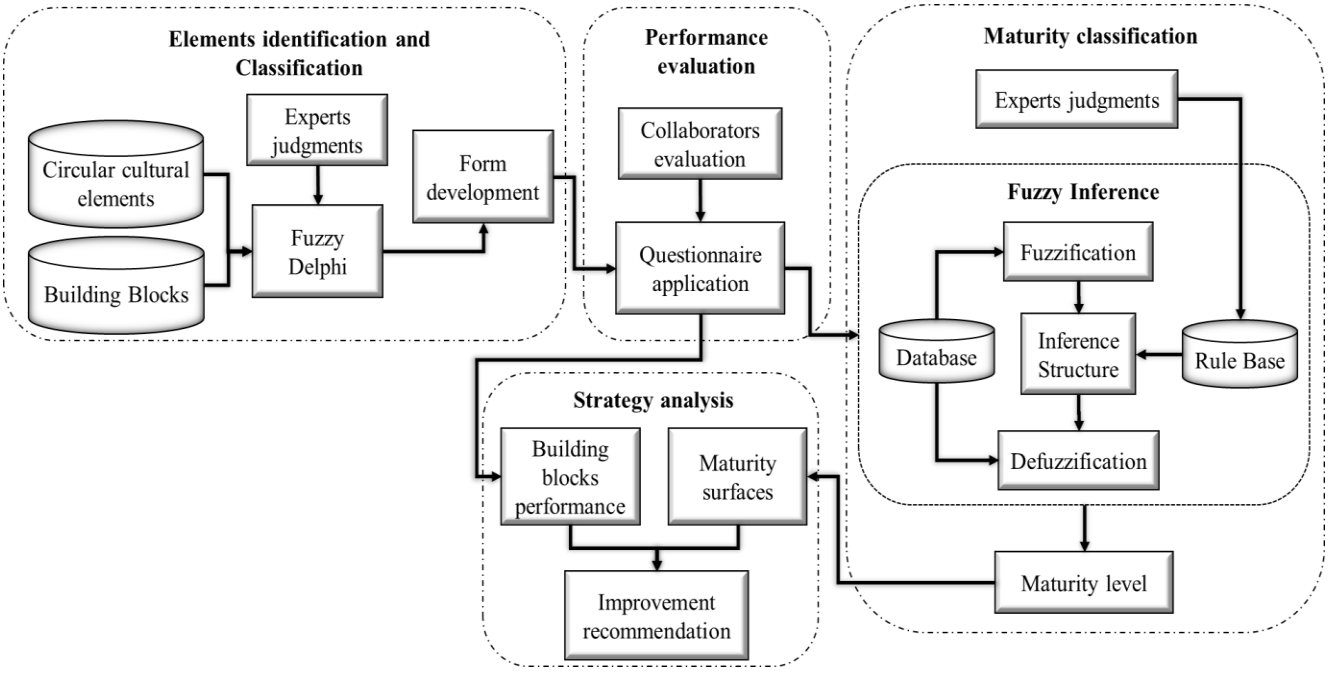
questionnaire and the application platform, ensuring that professionals would have no difficulty in answering it.

Step 4 – Evaluation: this step embraces the application of the assessment instrument through a pilot case study application. Then, we analyzed the CE-oriented culture readiness gap of the case in the study and proposed an action plan for the organization to move towards a more circular culture.

3.1.Proposed Assessment approach

Based on the methodological steps and in the literature review, we proposed an approach for assessing the CE culture readiness. Figure 2 presents the phases followed to develop the approach using fuzzy logic.

Figure 2: A proposed approach for assessing Circular Economy readiness



3.1.1. Identification and Classification of Elements

The elements that compose a CE-oriented culture were identified through an exploratory literature review. 151 elements were identified. The most important elements of this list were selected and classified into the five CE-oriented culture building-blocks (value, mindsets, behavior, capability, and competence) proposed by Bertassini et al. (2021) using the FDM applied through the steps below:

Define the experts and develop the questionnaire: the questionnaire was developed in a spreadsheet format to be sent to the CE experts to collect their perceptions, select and classify the elements. The experts judged them using a Likert scale from 1 to 5 (1 = unimportant; 2 = low importance; 3 medium importance; 4 high importance; 5 = essential), to classify the level of importance of each one of the elements for the maintenance of a CE-oriented culture related to each one of the proposed building blocks.

Determine the triangular fuzzy number for the evaluations of each element: with all the experts' answers, triangular fuzzy numbers are determined for each evaluated element (see Table C in Section 5 of the supplementary material) in each building block (Equations 1, 2, and 3 used are presented in Section 3 of the supplementary material).

Defuzzification of the defined fuzzy numbers for each element: with the triangular fuzzy number for each element in each building block the defuzzification operation (Equation 4 presented in Section 3 of the supplementary materials used to obtain a score crisp number as the output (See Table D in Section 6 of the supplementary material).

Filter the elements in each building block: based on the defuzzified numbers, the elements were selected and classified into the building blocks. First, similar elements were aggregated following the experts' recommendations. Then, to be considered part of a building block, the element score should be bigger than 4. The elements defined for each building block are presented in Section 4.1.

3.1.2. Performance Evaluation

The assessment instrument (questionnaire) was developed based on the elements identified in the previous phase. The questionnaire is divided into seven sections: an overview about the questionnaire and guidelines to answer it, five sections (values, mindsets, behaviors, capabilities, and competences) comprising the evaluation questions, and a section to collect generical data about the respondents (see the questionnaire in Section 7 of the supplementary material). The respondents followed a 1 to 5 scale (where 1- absent/understanding the potential; 2- planning/first implementation initiative; 3- planning the dissemination; 4- giving scalability, 5- totally present) to answer the questionnaire.

The rating average of each element was used to compose the total performance of the building blocks. The answers collected through this questionnaire were used as input for the

application of the FIS to evaluate and classify the cultural readiness of the organization to implement CE.

A pilot application of the proposed approach was conducted in a multinational mining and steel company operating in Brazil, whose defined fictitious name is the Alpha Company. Brazil is the 9th producer in the world ranking of steel production and this sector has greater importance for economic development since steel is used in a variety of products and industry sectors. In Brazil, the Alpha Company has an installed capacity of more than 12.5 million tons/year and employs around 17,000 people. Steel is the most recycled material in the world and is a versatile and permanent material with infinity potential of transformation. Thus, the Alpha Company takes advantage of such characteristics of steel and is involved with CE projects. We chose the Alpha Company for our application due to their potential to leverage the implementation of CE in Brazil.

3.1.3. Readiness Classification in Maturity Levels

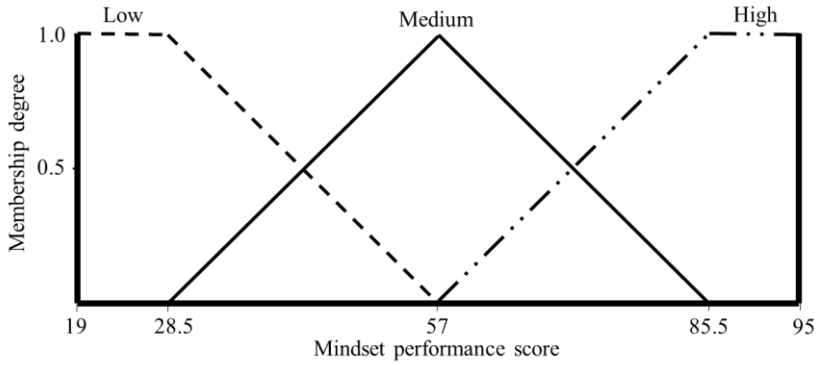
The answers collected by the questionnaire are used to classify the readiness of the studied organization to implement a CE-oriented culture in maturity levels. To do this, three linguistic terms are proposed to represent the performance of each building block (antecedent linguistic variable). The linguistic variables are represented by trapezoidal and triangular fuzzy numbers as shown in Table 2. Figure 3 presents an example of the fuzzy numbers used to represent the "Mindset" input variable. It should be noted that the universe of discourse of each building block depends on the number of elements present in it (The quantity of elements is not the same for all the five building blocks).

Table 2: Trapezoidal and triangular fuzzy numbers

Antecedent variable	**Linguistic Term**		
Building block	**Low**	**Medium**	**High**
Values	(18, 18, 27, 54)	(27, 54, 81)	(54, 81, 90, 90)
Mindsets	(19, 19, 28.5, 57)	(28.5, 57, 85.5)	(57, 85.5, 95, 95)
Behaviors	(7, 7, 10.5, 21)	(10.5, 21, 31.5)	(21, 31.5, 35, 35)
Capabilities	(14, 14, 21, 42)	(21, 42, 63)	(42, 63, 70, 70)

Competences	(17, 17, 25.5, 51)	(25.5, 51, 76.5)	(51, 76.5, 85, 85)

Figure 3: Example of the fuzzy numbers used to represent the "Mindset" input variable

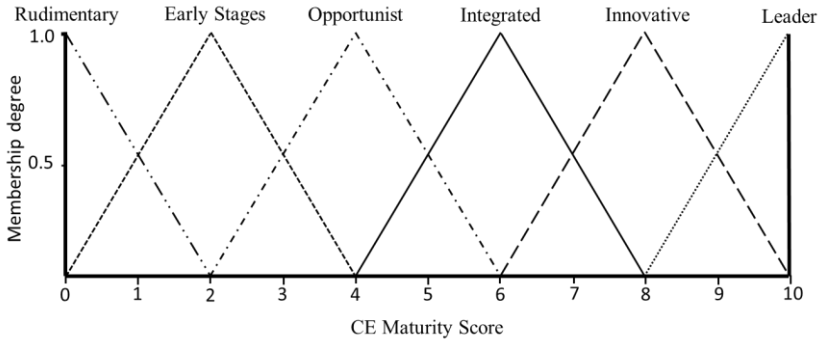


To define in which level of readiness an organization is classified, six linguistic terms are used as consequents variables, based on the CE-oriented Culture Readiness Levels presented in Table 1. The Triangular fuzzy numbers are used to represent these terms, as shown in Table 3 and detailed in Figure 4.

Table 3: Triangular fuzzy numbers used to represent the readiness levels

Maturity levels	**Triangular Fuzzy Numbers**
Rudimentary	(0, 0, 2)
Early Stages	(0, 2, 4)
Opportunist	(2, 4, 6)
Integrated	(4, 6, 8)
Innovative	(6, 8, 10)
Leader	(8, 10, 10)

Figure 4: Triangular fuzzy numbers used to represent the readiness levels



The rule base used in the model consists of 243 if-then rules (see Table E in Section 8 of the supplementary material). The consequent linguistic term for each rule was defined by a panel of 6 experts in the field and with in-depth knowledge of the interactions between the antecedents. The Mamdani Inference method is applied as presented in Section 2.3.2. After defuzzification, the organization is classified in the readiness level for which the defuzzified output has the highest membership degree.

Using the results of this phase, response surfaces, and the result of the questionnaire application, radar chart, it is possible to define strategical improvement recommendations to achieve a CE-oriented culture.

4. Results

This section comprises the presentation of the results, which are: the elements that characterize a CE-oriented culture (Section 4.1.), the performance evaluation and readiness classification of the studied organization (Section 4.2), and sensitivity analysis (Section 4.3).

4.1.Elements of a Circular Economy-oriented culture

The questionnaire, proposed in Section 3.1.1., was sent to eight professionals that are dedicated to studying and working in the field of CE for at least three years. The FDM application resulted in the classification of the elements for each CE-oriented culture building-block. 76 elements were selected and classified in 18 values; 19 mindsets; 7 behaviors; 14 capabilities; and 17 competences.

Table 4 shows the 18 selected circular values. Those values determine the criteria, patterns, or directional principles that demonstrate the things that are most important to achieve a

circular organization. These values could be explicit and communicated or they could be tacit and showed through actions but not communicated. They are the basis for mindset construction and translated into daily behaviors.

Table 4: Circular Values

	Value	Description
V1	Adaptability	It has the ability to adjust or adapt to local circumstances
V2	Audacity	It is bold to innovate and opposes the current standards
V3	Collaboration	It cooperates with stakeholders to create joint value, achieve common goals, and create a sustainable system. It is close to its stakeholders. It builds strong relationships and interactions with stakeholders, based on trust and sharing.
V4	Commitment	It is dedicated to the cause of CE and making efforts to achieve the organization's CE goals and values should be part of every employee
V5	Creativity	It is able to produce original and unusual ideas, or to do something new or imaginative
V6	Diversity	It prioritizes the value creation and delivery for diverse stakeholders. Diversity is good. Different sources of inputs, suppliers, sources of income, and workforce are better than only one source. It promotes a plurality of perspectives and solutions for CE and a culture of knowledge exchange and learning across society, generates a global knowledge base supporting local, context-dependent implementation, to build-in resilience against the uncertainty that accompanies transition processes with sufficient backup solutions.
V7	Effectiveness	Effective use of resources. It uses resources intelligently to achieve the objectives set
V8	Environmental-friendly	It uses recycled/ reused/ renewable material where possible. It embraces the use of environmental-friendly/sustainable materials
V9	Ethic	It has the fundamental assumption about what is morally right and wrong

	Value	Description
V10	Impact	It creates a positive influence in a situation, person, organization, society, or the environment. It minimizes resource consumption and environmental impact. It focuses on generating global positive impacts when the organization has global dimensions. It is able to reduce emissions and environmental footprint.
V11	Innovation	It creates and implements new ideas that can be applied in products/services, processes, business models, and value chains. Circular/sustainable-oriented innovation rather than profitability. The proposition of an interconnected set of innovation, where each one influences the other, with innovation both in parts of the system and in how they interconnect.
V12	Longevity	It focuses on the longevity of things. It extends the service life of products, materials, and components
V13	Regeneration	It prioritizes regenerative resources
V14	Sharing	It shares information, ideas, and resources with stakeholders. Open communication, mutual understanding, and the exchange of information, news, ideas, feelings, and the sharing of meaning are essential to support CE transition.
V15	Simplicity	It focuses on the simple, it produces in a simple, intuitive way, and with a visual layout; it makes it easier to use, understandable and easier to update
V16	Sustainability	It aims to provide economic, environmental, and social benefits simultaneously, and values the well-being of the current and future generations. Using resources within planetary boundaries, enhancing natural capital within and across generations. It creates a collective organisation of fair access to resources within and across generations to enable social and environmental quality
V17	Transparency	It carries out activities openly, so that people can trust in your fairness and honesty.
V18	Waste Reduction	It focuses on eliminating/minimizing residues at the source to minimize the amount needed to be treated and discarded

Table 5 shows the 19 selected circular mindsets. Those mindsets are the beliefs of the organization and its members that are aligned with CE principles and values and that determine how the organization interprets and responds to situations regarding the implementation of the CE.

Table 5: Circular Mindsets

	Mindset
M1	It makes all the stakeholders aware of the importance of inclusion and respect for ethical values, the preservation of the environment, sustainable development, and the guarantee of an adequate quality of life.
M2	Willingness to accept and embrace change as part of daily interactions and activities.
M3	It is concerned and perceives negative impacts of activities on the environment and society and pays attention to implementing of mechanisms that encourage sustainable development.
M4	It is able to change easily and adapt to different conditions and circumstances.
M5	It focuses on the future, that is, plan actions to anticipate future consequences. It has a long-term view. It embeds strong sustainability in political-economic systems, seeking a GDP growth to long-term multi-dimensional prosperity in environmental, social, and economic terms.
M6	It is humanitarian and wants good for humanity and improve the environment and social condition of a place and/or a community. It creates conditions that offer equity in achieving a quality of life that meets human rights standards for all.
M7	Inspired by people, especially leadership, to come up with new and creative ideas.
M8	It leads the transition. Intentionally influences stakeholders to move towards CE.
M9	It listens to comments, feedback, concerns, and new ideas, receives criticism and dialogue.
M10	It is proactive and anticipates future problems and/or needs, to change behaviors and situations in search of effective consumption and production results.

	Mindset
M11	Resilience is a state of life and gives us the ability to adapt business models and strategies according to continuous changes, adjusting trends capable of altering the business' profit generation. It is able to return to its original or improved state after being disturbed by some condition.
M12	It considers systems thinking and understands the interdependent relationships between various components that are part of the organization and its business ecosystem. It takes a whole system approach to understand challenges and the potential of proposed solutions in a precautionary way through a continuous improvement process.
M13	Learning about sustainability should not be restricted to leaders and senior managers
M14	Every unmet request of a customer is a potential new solution
M15	It nurtures a culture of civic responsibility and awareness surrounding resource efficiency. Move away from producer-driven consumerism and towards systems-of-provision that enable responsibly, reduce, demand-driven resource use and more sharing, service, and experience-based consumption.
M16	It refreshes one´s mind, seeing existing things differently
M17	It is comfortable with complexity and systems thinking
M18	It empowers the employees to come up with new ideas and opportunities to improve the product, business, and system circularity, and raises employees' awareness to contribute to the journey towards the CE
M19	Communicate and share know-how and experience across functions

Table 6 shows the 7 selected circular behaviors. Those behaviors describe how people and organizations are acting in the cause of CE implementation. Behaviors are daily actions carried out through appropriate capabilities.

Table 6: Circular Behaviors

	Behavior
B1	It influences, motivates, modifies the thinking or behavior of stakeholders to include the concepts of circular economy
B2	It establishes synergic relationships to be more successful and/or productive
B3	It communicates, commits and educates consumers about products issues and the merits of the circular economy
B4	It performs reverse logistics and establishes a system for recovering/ remanufacturing/ refurbishing/ recycling the used and defective products and parts
B5	It promotes the local market and local producers
B6	It trains ecosystem partners to make them aware of circular economy issues and to establish a closer relationship
B7	It manages an open ecosystem with new forms of collaboration and engages in open innovation

Table 7 shows the 14 selected circular capabilities. These capabilities describe the proper theoretical knowledge on CE concepts (qualification) with the ability to perform these concepts (know how to do). These capabilities become competences when they are supported by attitudes.

Table 7: Circular Capabilities

	Capability
C1	Ability to sell outcomes and lifecycle services. It is able to develop new offers and pricing models focused on outcome-oriented solutions
C2	It is able to understand, coordinate, engage and manage the ecosystem partners and different stakeholders to share resources, operations, close the loop and co-innovate

	Capability
C3	It is able to design effective and dynamic systems; business models and intelligent products for longer and multiple life cycles.
C4	It is able to integrate circular economy principles into product design
C5	It is able to understand dependencies, risks, and opportunities through a sustainable and circular lens
C6	It is able to give guidance on how to use the product throughout its life cycle
C7	It is able to establish return systems to add value to products and facilitate the disposal of end-of-life products
C8	It is able to integrate technologies to monitor, track and sort materials and product flows
C9	It is able to attract new talents with circular values and motivate old employees
C10	It is able to enable a culture shift to embrace cross-functional collaboration, system thinking, and customer-centricity
C11	It is able to develop and implement metrics to measure the performance over time and to incentivize the development of circular capabilities
C12	It is able to transform the linear supply chain into a circular one
C13	It is able to collect data, develop and initiate circular programs and communicate outcomes
C14	It is able to optimize values from products and increase the use of capacity

Table 8 shows the 17 selected circular competences. These competences describe the combination of the capabilities implemented repeatedly with the attitudes to implement these capabilities (know how to behave) to be successful in CE implementation.

Table 8: Circular Competences

	Competence
Co1	Embedding sustainability should include technical and action learning opportunities

	Competence
Co2	Working close to the consumers, including them in the product design, and understanding their user journeys and needs
Co3	Establishing a proper system to recover materials at end-of-life and reuse them in their production or share with ecosystem partners
Co4	Training employees in circular economy issues to educating them and to bring in concrete projects to work on
Co5	Establishing effective and transparent communication with stakeholders to share information and opportunities about circular and environmental initiatives
Co6	Ability to design products for circularity. Design, select and transform industrial systems, supply chains, materials, and products, using "R-ladders" and whole-system assessments of solutions.
Co7	Ability to create synergies, define and map out the ecosystem stakeholders
Co8	Ability to source and use recycled or recyclable materials
Co9	Ability to deploy technologies and data for delivering outcomes
Co10	Ability to develop, transform and motivate circular competences, outcomes, and jobs
Co11	Ability to understand product functions, maintenance procedure, failure mode, and wear by using
Co12	Able to negotiate new types of contracts considering the diverse roles that each stakeholder can perform
Co13	Able to put the customer at the centre of product design and delivery value-adding solutions
Co14	Able to map out the customer stakeholders, understand their needs, engage them in the sales process and the product lifecycles
Co15	Able to prolong the life of products, components, and materials developing services and after-sales offering
Co16	Able to eliminate the use of a hazardous substance and access materials that can easily be regenerated and recycled

	Competence
Co17	Able to build, maintain and expand CE understanding among ecosystem partners (including workers and customers) to train and support the organization and identify new opportunities and improvements

4.2.Performance evaluation and readiness classification

The questionnaire, proposed in Section 3.1.2., was answered by 19 employees from the Alpha Company in the areas of sustainability & environment; innovation & product development; culture & innovation competences; governance, risk & compliance; and research & development. Moreover, 15 of the 19 respondents play the role of innovation agents within the company. As it is a large company, the sample of respondents was selected so that some representatives from the main areas of the company would participate in the assessment. This sample is sufficient to understand the cultural orientation of these areas towards CE. Information about the respondents is presented in Table 9.

Table 9: Respondents' Information

Respondents	Area	Innovation Agent	Level of knowledge in CE
R1	Environmental Management	Yes	Some knowledge in CE
R2	Research & Development	Yes	Some knowledge in CE
R3	Research & Development	No	High level of knowledge in CE
R4	Research & Development	Yes	Some knowledge in CE
R5	Research & Development	No	Some knowledge in CE
R6	Research & Development	No	Some knowledge in CE
R7	Research & Development	Yes	High level of knowledge in CE

Respondents	Area	Innovation Agent	Level of knowledge in CE
R8	Research & Development	Yes	Some knowledge in CE
R9	Research & Development	Yes	High level of knowledge in CE
R10	Research & Development	Yes	Some knowledge in CE
R11	Research & Development	Yes	Some knowledge in CE
R12	Research & Development	Yes	High level of knowledge in CE
R13	Research & Development	No	High level of knowledge in CE
R14	Innovation & product development	Yes	Some knowledge in CE
R15	Governance, risk & compliance	Yes	High level of knowledge in CE
R16	Sustainability & environment	Yes	Some knowledge in CE
R17	Culture & innovation competences	Yes	High level of knowledge in CE
R18	Innovation & product development	Yes	Some knowledge in CE
R19	Sustainability & environment	Yes	High level of knowledge in CE

The results obtained from the questionnaire were used as input data (see Tables F to J in Section 9 of the supplementary material to consult the answers obtained through the questionnaire application), and it is summarized in Table 10. The parameters used to define the fuzzy numbers applied in the fuzzy inference system were previously presented in Section

3.1.3. Table 2 presents the input parameters, while Table 3 presents the output parameters for CE maturity classification. The FIS used the "Minimum implication operator" represented in Eq. 6, and the "Max-Min composition operator" presented in Eq. 3. The "Max operator" shown in Eq. 8 was used for the aggregation of the composition operations. Finally, the resulting "crisp" defuzzified number was obtained through Eq. 9. All the operations were carried out using the fuzzy MATLAB© toolbox.

Table 10: Results obtained from the questionnaire and used in the FIS.

Antecedent variable Building block	**Input data used in the FIS**
Values	61
Mindsets	62
Behaviors	22
Capabilities	44
Competences	57

The output value of 5.54, on a 0 to 10 scale, was obtained as the organization's current performance in terms of readiness to implement a CE-oriented culture. Thus, the Alpha Company is classified at the "Integrated" level, which means that Alpha has some knowledge and experience in CE concepts and practice. It incorporates CE principles in some of its products/services and processes. It already captured some values regarding the implementation of circular strategies, and these strategies are formalized in documents and processes. It is engaged in the transition to a more circular model and it shares values that cultivate circular behaviors and mindsets. However, as was confirmed by the Alpha Company Sustainability Report and by some interviews with the questionnaire respondents, Alpha has a long way to go in the transition journey towards CE. Despite Alpha having many actions and projects oriented to the CE implementation, they are just incremental circular innovations and mostly focused only on recycling.

FIS application results in the surfaces are presented in Figures 4 to 13. |From the evidence, it can be compared how a building block behaves concerning another. The surfaces present 3 dimensions: the organization's current performance in one dimension and one building block in each one of the other two dimensions. In general, the surfaces demonstrate that not one factor has a major impact on the others in the context of the Alpha Company. In each one of the surfaces, two building blocks can be compared and it can be analyzed which one should be more developed for the company to achieve CE maturity.

By observing the current point in which the organization finds itself, some elements that were not yet implemented can be prioritized to increase the level of maturity more quickly. As can be observed in Figures 5, 7, 10, and 13 the compared building blocks show that there are not just one of them that should be chosen to put effort. Their comparison shows that the shorter path to a CE-oriented culture, in this case, is to simultaneously improve: the mindset combined with the value (Figure 5); capability combined with the value (Figure 7); capability combined with the mindset (Figure 10); or competence combined with behavior (Figure 13). In Figure 6, moving towards the development of 'values' over 'behaviors' may bring better results. On the other hand, Figure 8 shows that moving in the direction of 'competence' may be a better option when compared to 'values'. Meanwhile, Figures 9 and 11 show that prioritizing 'mindset' over 'behavior' and 'competence' may be a more effective path. Similarly, Figures 12 and 14 show that 'capability' should be prioritized when compared with 'behavior' and 'competence'.

Figure 5: Mindsets x Values

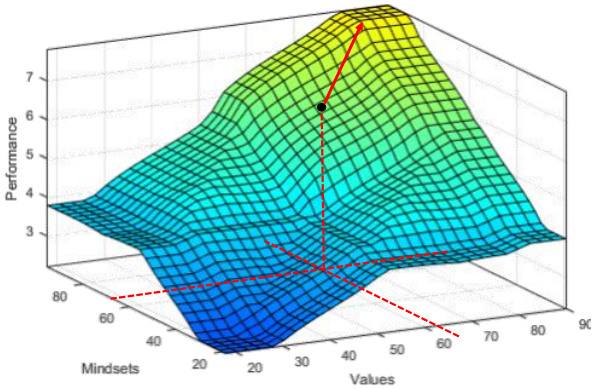


Figure 6: Behaviors x Values

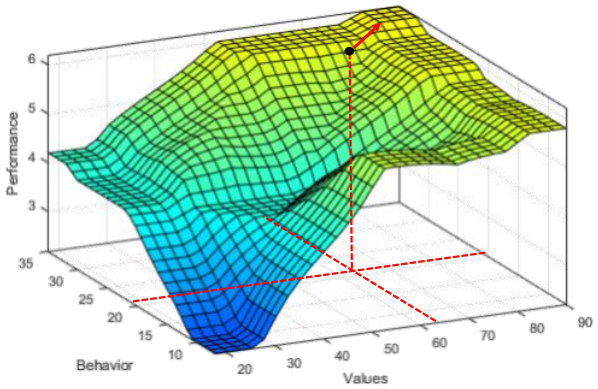


Figure 7: Capabilities x Values

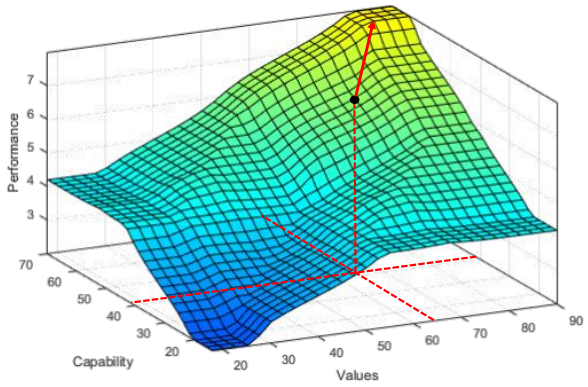


Figure 8: Competences x Values

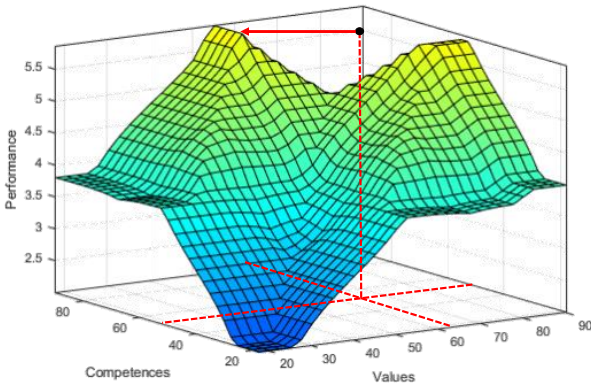


Figure 9: Behaviors x Mindsets

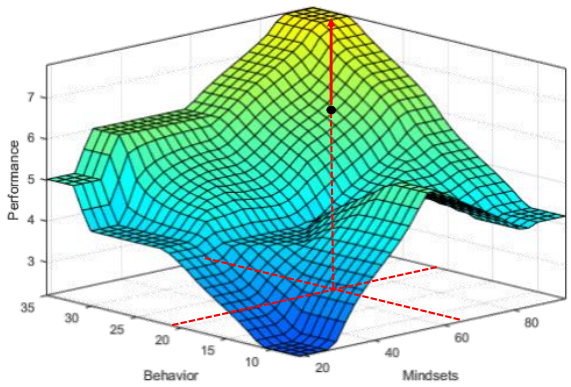


Figure 10: Capabilities x Mindsets

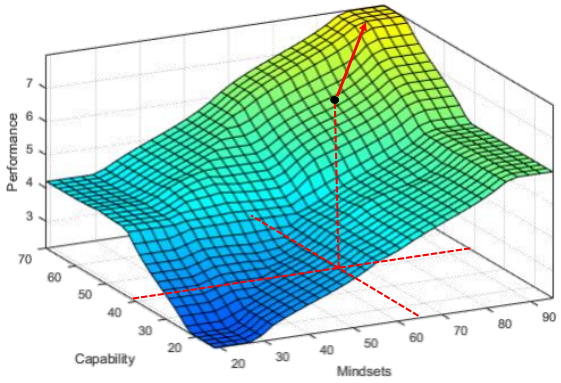


Figure 11: Competences x Mindsets

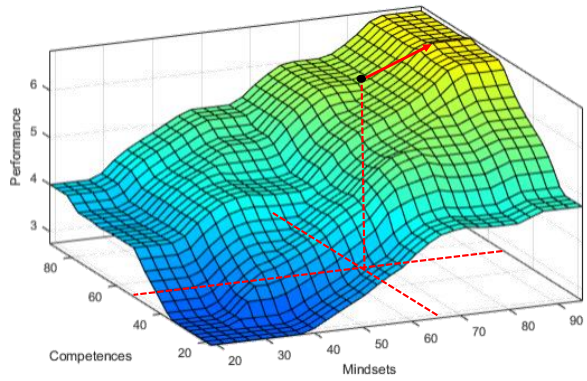


Figure 12: Capabilities x Behaviors

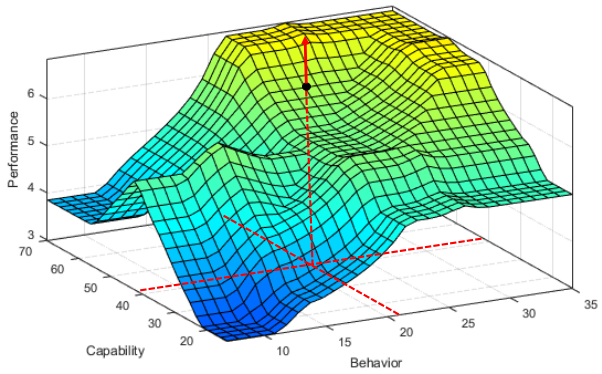


Figure 13: Competences x Behaviors

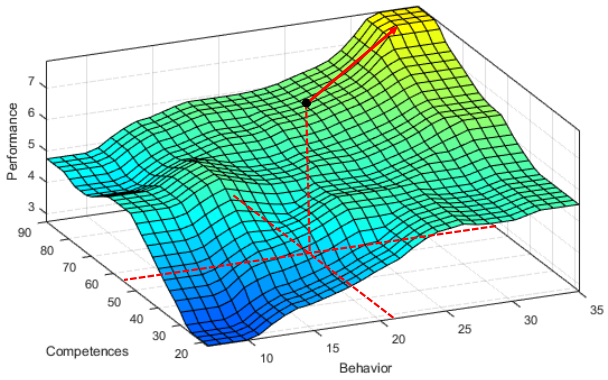
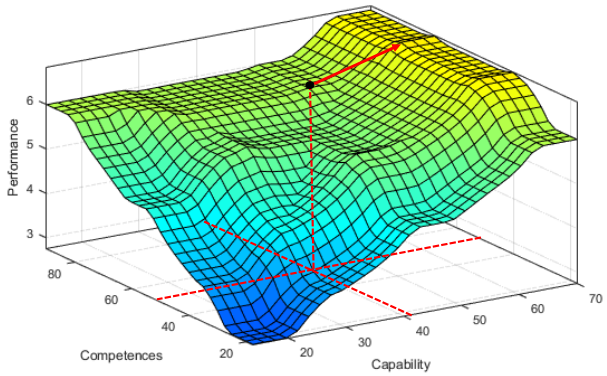


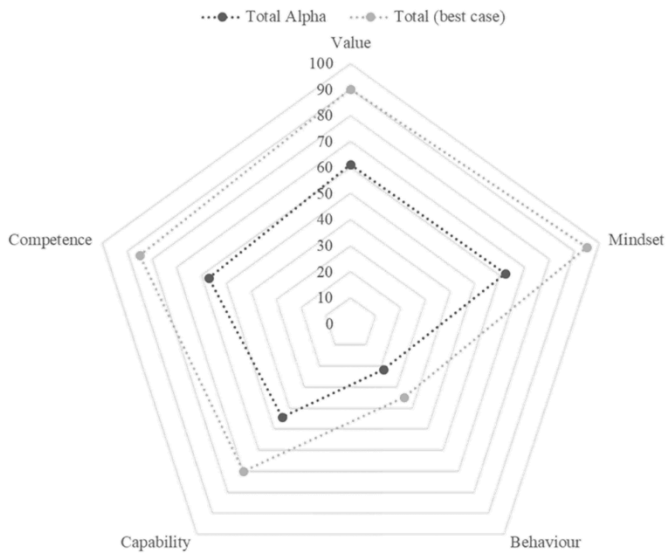
Figure 14: Competences x Capabilities



The analyses inferred by the surfaces are complemented by the results of the radar chart presented in Figure 15. It portrays the company's performance in each CE-oriented culture building block compared to the best case that a company could achieve. Radar charts are used for representing multidimensional data. They are best for determining which variable in a data is doing better than the rest and are mostly used for performance analysis. As can be observed, the Alpha Company has a long way to go to improve its readiness in a CE-oriented culture. The building block in which they performed better is in 'behavior' (21 points from a maximum of 35), however, in the other building blocks the organization should make an effort to perform better.

We propose that the Alpha Company Alpha should make an effort to improve their mindsets and capabilities oriented towards CE. Bertassini et al (2021) affirm that is easier to conduct changes in the building block values, behaviors and capabilities because they are more tangible than mindset and competences. In the case of the Alpha company, they will need to analyze this in more depth and improve their capabilities (tangible and technical) they need to improve their mindsets (intangible and soft) to achieve a better CE-oriented culture performance. Focusing first on implementing the elements that comprise these two building blocks, the Alpha Company has the potential to improve its readiness level to have a CE-oriented culture. After improving the mindset and capabilities, they could focus on improving values, and improving behaviors and competences. It should be noted that the proposed approach is cyclical, so it should be continuously applied to monitor the evolution of the organization in the readiness levels.

Figure 15: The Alpha Company's performance in the building blocks



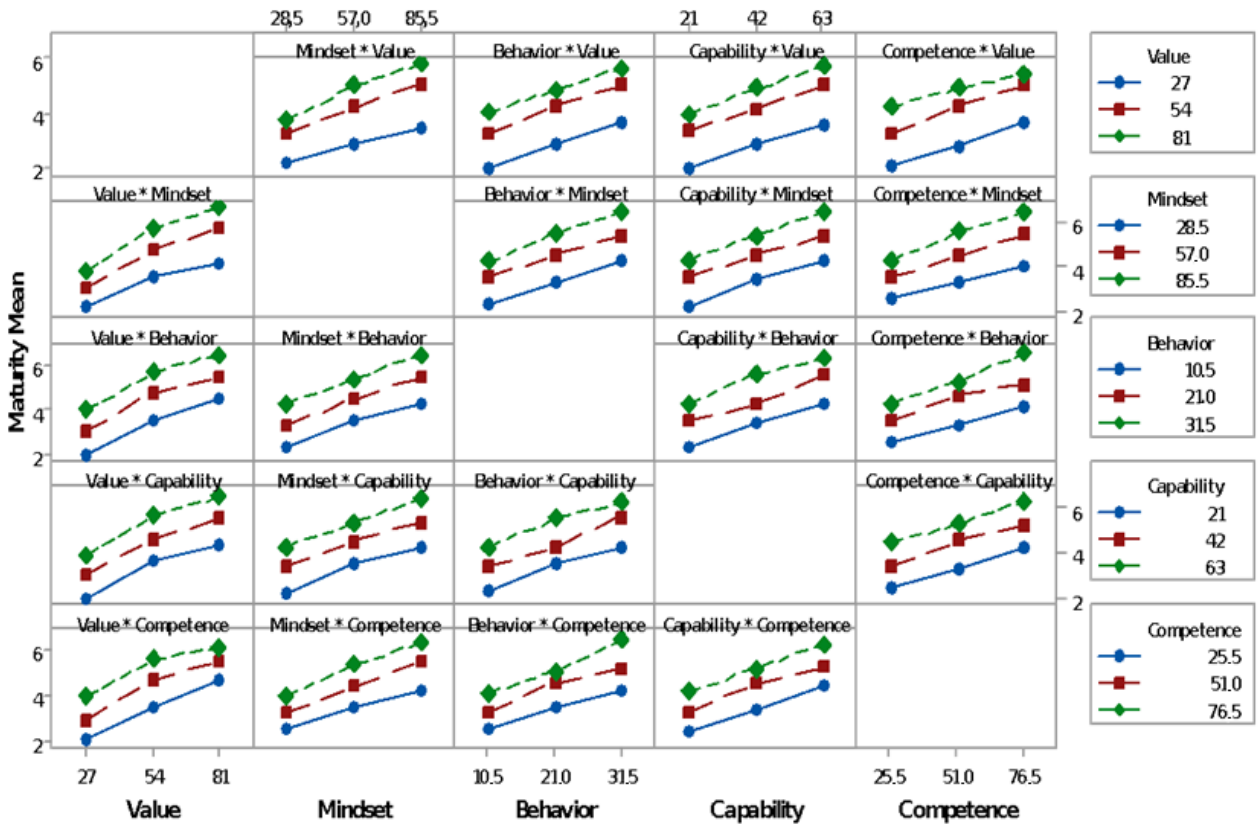
4.3.Sensitivity analysis

Sensitivity analyses are used to validate decision models (Delgado and Sendra, 2004). The full factorial design technique (Montgomery, 2017) is commonly applied used to assess the effect on the response of interactions between input variables and to assess the relative importance of input variables based on the FIS rule bases (Zanon et al., 2020; Osiro et al., 2014; Lima-Junior et al., 2013). Thus, to analyze the consistency and sensitivity of the applied inference systems, a full 3^k factorial design technique was carried out using the Minitab 17® software.

As described in the previous sections, the FIS applied in the proposed tool has 5 input variables, which are the building blocks of a CE-oriented culture. These 5 factors were evaluated considering the 3 possible levels represented by the linguistic variables “low”, “medium” and “high”, which generates a combination of 3 (243) input variables. The values related to the highest membership degree for each criterion concerning each linguistic term were used as input data for the factor analysis. Table K in Section 10 of the supplementary material presents the randomized experimental design performed and the respective defuzzified results for the tested dataset.

Figure 16 presents the interaction effect graphs of the input variables. The x-axis of the graphs presents the values referring to the tested linguistic terms, and the y-axis represents the output of the FIS according to the interacting input variables. In the graphs in Figure 15, if the lines are not parallel at all, it indicates a strong interaction between the variables. On the other hand, if the lines are parallel (or close to parallel), it indicates that there is no interaction between the variables. By analyzing the graphs resulting from this analysis, it can be concluded that there is no trade-off relationship between the input variables. Therefore, the graphs and response surfaces show that the input variables (building blocks) do not differ greatly in their impact on CE maturity. Furthermore, it reinforces that the theoretical supposition of the factors (building blocks) complements each other in the development of a CE-oriented culture.

Figure 16: Interaction effect graphs of the input variables



5. Discussion

CE is perceived as a promising approach to SD and as a framework to implement the SDGs. At local and national levels, governments are developing action plans to include CE in development goals (Ogunmakinde et al., 2022) as they emphasize the regeneration of products rather than their disposal (Ghisellini et al., 2016) and guarantee the circularity of products in the system (Ogunmakinde et al., 2022), resource efficiency and waste minimization (Barón et al., 2020). Sustainable CE innovations applied in business models, supply chains, and business ecosystems, and the implementations of new technologies are considered key aspects for the transition towards CE (Konietzko et al 2020; Pollard et al., 2021). However, due to cultural/behavioral aspects, companies do not understand the positive outcomes that sustainable CE innovations could generate, which makes companies struggle to adopt circular business models (Salvador et al., 2020).

Cultural and behavioral aspects must be directed towards a sustainable CE; thus, organizations can have the required basis and support to propose such innovation so that they can transmit long-lasting CE concepts (Bertassini et al 2021a). Therefore, mapping the CE elements is essential to allow organizations to improve their performance in the transition towards a CE-

oriented culture and carefully consider and mitigate the rebound effects that could be generated from implementing CE practices.

The rebound effects are mostly related to operational 'errors' when implementing practices (Salvador et al., 2020) that do not fit with the adopted culture/strategy. Therefore, developing a CE-oriented culture might create awareness in the organization that a circular system needs to be thoughtfully designed aiming to prevent all the possible rebound effects. Not considering the rebound effects from the beginning may lead to an overstatement of the benefits of certain innovations, which can lead to increases in emissions targets, preference for recycling (Siderius & Poldner, 2020), overuse of products in solution-based models, insufficient secondary materials or products and price effects (Salvador et al., 2020). Thus, developing the CE-oriented culture elements means that organizations must have their culture properly focused on the design of the circular system from the beginning and focused on the ecosystem to build a strategic partnership that is the key for CE transition and rebound effect control.

The culture of organizations that seek circularity should enable the explicit value proposition of circular business models with a broader and long-term orientation. The CE-oriented culture must shift from interaction based on transactions to one based on shared values, which in the long run will help achieve sustainability. A CE-oriented culture must involve social innovations driven by transformative use of resources, connecting grassroots initiatives, ideas, and opinions to local, national, and supranational policy development and decision-making.

The readiness assessment approach proposed based on the CE-oriented culture building blocks and its elements allow organizations to see how well they are performing on each one of the building blocks and identify which ones they should develop actions to go further in their journey towards the CE. Having a CE-oriented cultural awareness and knowing the cultural readiness to move towards CE might guide companies in the achievement of SDG 12 (sustainable production and consumption) (Belmonte-Ureña et al., 2021). Performing the CE-oriented culture readiness assessment might encourage companies to adopt sustainable and circular practices (SDG 12.6); disseminate CE and sustainable knowledge through the business ecosystem and ensure that people have the relevant information and awareness for SD (SDG 12.8); and through implementing the CE-oriented elements, support government and developing countries to strengthen their scientific and technological capacity to move towards sustainable production and consumption (SDG 12.A) (United Nations, 2022; UNEP, 2022).

Using the readiness assessment approach gives a clearer vision of the cultural performance of companies about CE implementation and can create a sense of urgency in implementing CE-

oriented culture elements and CE practices. This can lead to positive impacts in the environment (e.g., reducing greenhouse gas emissions, reducing de use of virgin materials, resource efficiency, and reuse), economical (e.g., resource productivity, lower production costs, creation of jobs), and social (e.g., creating avenues from mutual trust and partnership between communities and industries, boosting community well-being, resolving economic disparities and fostering social equality) spheres (Ogunmakinde et al., 2022).

Moreover, using the readiness assessment approach is a way to move away from the techno-centric CE narrative and puts the human aspect at the center of the CE transition. According to Schröder et al., (2020), putting humans at the center of CE will encourage the development of solutions to structural unemployment; adoption of business models that align business values with social impact that engage Bottom of Pyramid populations; strengthening community resilience and belonging; and promoting sustainable lifestyles. In the Global South, as is the case of Brazil, populations that are not part of any business ecosystem, with CE implementation, have the opportunity to become part of the solution.

Both theoretical and managerial implications are offered herein.

5.1.Theoretical Implications

To the best of the authors' knowledge, there is no previous study that combines MM, fuzzy set theories, CE and OC to propose an assessment approach. In this sense, this research has a multidisciplinary theoretical contribution as it combines divergent topics in a single proposition. It can be observed that the number of multidisciplinary studies in the CE field is increasing, showing the relevance and importance of this study. This study presents an adaptable methodology used to develop the approach that could inspire the solution of similar problems in different research areas.

The approach uses a quantitative approach based on fuzzy sets that allow modeling readiness to CE transition from qualitative, inaccurate, and vague data. This is a valuable way to analyze the culture orientation, as decision-makers' opinions can be more accurately processed and the knowledge of the problem domain captured and maintained in the system. Moreover, to the best of the authors' knowledge, this is the first time that fuzzy logic is used to develop an assessment model for a CE-oriented culture context.

The results of the pilot application showed that using the fuzzy techniques combined with MM theory allows the development of a quantitative model capable of capturing inaccuracies of human reasoning (Caiado et al., 2021; Zadeh, 1965), and provides a useful way to deal with

vague and uncertain data and estimates a global maturity score based on the readiness level dimensions (Aqlan & Lam, 2015) and considering non-linear relationships between input and output variables (Zanon et al., 2020). Thus, the application of FIS for the development of this readiness assessment is an appropriate tool.

Adding to the existing MM, the assessment approach presented here brings additional information using the elements that characterize the CE-oriented culture. It can be applied independently by any company and it shows measurable results. Regarding the development, the proposed approach and techniques were tested through a pilot application and sensitivity analysis showed that the effects on the responses of interactions between input variables used in the approach are consistent. Moreover, the paper presented a detailed description of the construction process and offered guidelines for its application, ensuring reproducibility.

5.2.Managerial Implications

From a managerial perspective, this paper presents a scientific approach intended to help companies achieve CE, providing guidance that enables them to gain awareness regarding the true level of readiness towards a CE-oriented culture. In general, companies struggle to identify their actual CE-oriented culture level, and it is unclear to them what actions they should take to obtain improved results. Thus, companies could use the result from the assessment to choose the building blocks that they should prioritize and, based on the building block, select the elements that they will implement to achieve a CE-oriented culture. The evidence collected in the testing phase showed that the proposed approach is of great help to give managers insights and guidance about which path the organization should follow to achieve a CE-oriented culture quickly. This approach is adaptable to remain applicable to any organization, irrespective of size, sector, location, and technology intensity. It helps managers to improve their journey towards CE and give support for more precise decision-making regarding CE transition. Moreover, the proposed approach can be integrated into toolboxes used by companies for internal benchmarking and road mapping for circularity.

5.3.Limitations

As with every study, our study has some limitations. First, in the pilot application, an overview of the CE-oriented culture was obtained from only a few areas of the organization. To have a systemic vision that represents the entire organization, a bigger sample should be defined to answer the questionnaire. Second, only one company from a specific industrial sector with its characteristics was evaluated.

6. Conclusions

This study proposed a novel approach to assess the readiness of companies to implement a CE-oriented culture based on the application of fuzzy techniques to overcome the complexity, inaccuracy, and uncertainty inherent in the study of OC combined with CE. The main results are: classification of an organization into six levels of readiness to implement a CE-oriented culture; a pairwise comparison of the performance of the organization between the building blocks; and a radar chart with the overall performance of the organization regarding CE-oriented culture. The results provide organizations with specific information and guidance for decision-making regarding the changes that should be made to adapt or change the existing culture to one that comprises the specificities of CE. Organizations that focus on radical innovations and balance the efforts between technical and soft aspects are more oriented towards a CE culture. It was also identified that making a more in-depth analysis of the presence of CE-oriented culture elements in the organization may contribute by mitigating possible rebound effects that could be generated from implementing CE practices. The application of the proposed approach might be a way to create sustainable and circular awareness in the organizations that see sustainability-related action as obligations showing them the power that a CE has to generate value in all its forms.

As future research, the tool may be applied to a bigger sample of respondents in studies on organization to have a systemic view, as this organization is in the process of disseminating CE concepts and projects to the entire organization. Another opportunity is to apply the assessment instrument with different organizations (different sectors, sizes, countries), to further validate the proposal as well as to analyze if there are significant discrepancies regarding the readiness in different contexts. Further research could also evaluate readiness at different times by applying a roadmap with periodic goals. The creation of a digital platform to apply the readiness assessment approach with different organizations and using the results as benchmarking for the companies is understood as a future research opportunity. It should be noted that the importance of the elements evaluated may change depending on the panel of experts involved and the types of resources available to the organization's context. In addition, future work can apply other MDCA (Multi-Criteria Decision Analysis) techniques to rank and select the elements that will be used in the maturity assessment. Furthermore, different fuzzy information representations can be applied, such as hesitant fuzzy, intuitionistic fuzzy, and dual hesitant fuzzy to deal with hesitations in the subjective judgments of the experts.

Acknowledgments

The authors gratefully acknowledge the financial support of the Brazilian research funding agencies Coordination for the Improvement of Higher Education Personnel - CAPES (001), São Paulo Research Foundation - FAPESP (2018/24830-6 and 2018/21129-5), National Council for Scientific and Technological Development - CNPq (306458/2019-5); and the company that participated in the illustrative application presented in this research.

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APPENDIX H – PAPER 8

Bertassini, A. C., Piller, F.T., & Gerolamo, M. C. (2023). Opportunities and Challenges of Mass Customization for Circular Economy: a literature-based analysis. MCPC 2023.

Opportunities and Challenges of Mass Customization for Circular Economy: a literature-based analysis

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Abstract. Moving towards circular business models (CBM) may contribute to the achievement of a more sustainable society while strengthening the competitive advantage of organizations. Consumers and other key players should intensively and closely participate in CMB due to its essential role in closing loops. Mass Customization (MC) is discussed as a way to work closely with the consumer. However, the research on the synergies between CE and MC is still in its infancy. Furthermore, the few findings available in the literature are sometimes conflicting. This paper aims to synthesize the synergies, opportunities, and challenges of MC for CE through a theoretical study based on a systematic literature review. Our results highlighted that co-creation and communication, design strategies, and material and energy efficiency are some synergies between MC and CE. MC for CE has great potential, although, it might be extensively analyzed case by case to make sure that the closed-loop strategies are suitable and do not result in rebound effects. Besides advancing the understanding and the debate on the relationships between MC and CE, our results also outline directions for further research on refining MC to enable the CE transition.

Keywords: Mass Customization. Circular Economy. Sustainability.

Introduction

The global economy only cycles 8.6% of what it is used to [1] highlighting a huge circularity gap of over 90%. This demonstrates the persistence of the linear model of take-make-dispose culture and the power of the business-as-usual in all sectors of the economy. Hence, a Circular Economy (CE) approach is considered a strategic path to reduce the circularity gap. CE has a plethora of definitions, but most of them can be translated in the definition proposed by Kirchherr et al., [2]: "CE is an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes. It operates at the micro level (products, companies, consumers), meso level (eco-industrial parks), and macro level (city, region, nation, and beyond), intending to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity, and social equity, to the benefit of current and future generations. It is enabled by novel business models and responsible consumers."

In this study, we consider the CE applied at the micro level, which means that here, the concept of CE is understood as a way to reuse and repair products; recover components and use them into new products or for new uses, and even, restructuring a system so that the waste of one process can be the feedstock for another one [3]. In CE, the design of products not only focuses on functionality but also on managing the end-of-life infrastructure considering how the products, materials, and components can be used more and for longer [4] and how they can become parts of a new production chain [5]. Mass Customization (MC) is already applied with sustainability goals and it can be a useful 'tool' to implement CE.

MC is a term used for "all kinds of strategies connected with high variety, personalization, and flexible production" [6]. MC describes the idea of profiting from heterogeneous markets by offering customized products or services according to the individual needs of the customers [7] with similar prices offered by mass production

[27]. MC product is characterized by its modular architecture [8;9] and the use of digital technologies (such as Cyber-Physical Systems and the Internet of Things) [31] to make an MC system viable, which can lead to advantages in terms of economies of scale and more sustainable and circular manners to deal with the product at the end of its first life cycle [10; 11].

A lot of studies [8; 9; 10; 12; 13] discussed the topics of MC and CE; however, these topics are usually discussed individually (or connect some aspects of sustainability), failing to recognize their interdependency and synergies. Recognizing interdependency and synergies is crucial because MC can become a key enabler of CE and dramatically change the lifecycle of products. Moreover, the digital technologies related to industry 4.0 can be an enabler for both MC and CE implementation leading to a complete change in processes and even business models. Thus, this paper aims to synthesize synergies, opportunities, and challenges of MC for CE through a theoretical study based on a systematic literature review (SLR).

Methodology

To identify the opportunities and challenges that MC has on CE; we conducted an SLR. An SLR is a means of obtaining subsidies for evidence-based practice, which allows ordering, from a given period, a set of information and results already obtained on a given topic, to investigate consolidated points of knowledge and identify new research guidelines [14]. A rigorous SLR requires a proper replicable procedure. Thus, we followed the steps recommended by [15]: (I) definition of review scope (section 1); (II) conceptualization of topic (section 2); (III) literature search (section 3); (IV) literature analysis and synthesis (section 4); and (V) research agenda (section 5).

We started with an analysis of the topics (CE and MC) to identify suitable keywords. To determine a useful search string, we combined the search items defined as the scope of this study and some variations of them: circular economy; circular business model; sustainability; mass customization. Next, we selected the databases: Scopus, Web of Science, and EBSCO to get a broad and interdisciplinary overview of research combining aspects of sustainability/circular economy and mass customization. The string used to search for publications in the defined databases was: ((“circular economy” or “circular business model” or “sustainability”) and (“mass customization”)). The search was conducted by ‘title’ to focus only on publications that have an explicit focus in this discussion. In total, we selected 15 publications that had contributions regarding the connection between CE/sustainability and MC. To include specific MC and CE literature, we selected the main authors in the field and some cross-references from the publications analyzed in the SLR.

Results and Discussion

Creating alternatives to achieve sustainability through CE implies the development of competencies such as proposing new offerings, new customer experiences, new value capture, new processes, and new supply chains and networks. Some aspects that CE-oriented innovations should include are a better use of resources combined with economic value retention through reuse, repair, and remanufacturing [16] and other value optimization strategies; the perspective of long-term use of materials, and durability [17]; the generation of opportunities for social inclusion – i.e.; creating new jobs in the alternative value chains [18]; and considers a multi-level approach to enable the sharing of knowledge and resources [19] in all levels and dimensions of a business (e.g., policies and regulations, production and consumption, supply chains, business models, business ecosystems). Moving towards CE includes a diversity of stakeholders and key players, including the customers, that must intensively and closely participate in the process of innovation (including implementation) towards CE due to their potential and essential role in closing loops. In this regard, MC is a way to work closely with the customer since its core concept is serving customers individually through a high-variety product offering [20].

Although CE and MC are mostly studied and applied as totally divergent and separate concepts in literature, there are some synergies between the concepts (see Table 1) that make it worth investigating the opportunities and challenges of the combination of both concepts in theory and practice. Co-creation is the first synergy highlighted by some authors [7; 8; 9; 10; 11; 21; 22; 23]. The innovation process is assured by co-creation activities [24] and by co-creation, unusual and new ideas can be developed, acknowledging the presence and the coworking of several stakeholders at the same time [25]. CE is innovation and so is MC, thus, co-creation is essential to enable the development and implementation of CE and MC strategies and practices. CE has a broader perspective regarding co-creation since it includes not just the customer as MC, but other key players of the business ecosystem [26]. In short, co-creation establishes an intensified relationship between the stakeholders and mainly the customers through the involvement in the design process of a product/solution [21]. This co-creation during the design phases enables the customers to specify some product properties to maximize the utility of the product or service for oneself [8] which could create an emotional attachment of the customer towards the product and company during

the customization process [10; 22]. In a broader sense, co-creation during the initial phases can be a way to align roles between stakeholders and enhance engagement.

Table 1. Synergies between Mass Customization and Circular Economy

Mass Customization	**Circular Economy**
Co-creation (co-design) with customers	Co-creation with stakeholders
Interaction/Communication with customers	Interaction/Communication with stakeholders
Modular design & Design for X	Eco design
	Value optimization
	Material and Energy Efficiency
	Life Cycle Thinking
Build-to-order & Postponement	Material and Energy Efficiency
Platform	Dematerialization
	Service Nature (Product-as-a-Service)
	Closed-loop supply chains
Digital technologies	Digital technologies

In parallel to co-creation is the interaction/communication with customers and other stakeholders which is another synergy between CE and MC. Interaction and communication with stakeholders are very powerful tools to create awareness [10] (in customers, employees, and partners) and understanding about CE and sustainability and communicating the CE benefits and solutions. The interaction with the customer is the key to MC since through this interaction and communication the customers can choose features of their products [7; 21] and exchange valuable information with each other [23]. With this interaction and communication, it is also possible to aware the customer of the impacts (positive or negative) of the choices that they make for their products [10].

Modular design and design for X are other synergies between CE and MC that allows the eco-design of products; the value optimization of products, materials, and components; the efficiency of materials and energy; and the inclusion of life cycle thinking in the business strategy as a whole. Modular design gives manufacturers the possibility to produce different products using standard components [3; 11]. Moreover, it offers a personal configuration without additional notable costs through the combination of modular components [3; 27]. The modular design also extends in form of flexible operations to the production processes and supply networks [28] and this practice is also mentioned in studies of product-as-a-service business model as an important factor to consider as the modular design do not only help to reduce process time and cost but also extend the durability and longevity of products [9]. The design for X is another way to improve CE adoption through MC [10] because it includes eco-design strategies and processes to design products, materials, and components for multiple use cycles and it is a useful tool for the continuous improvement of the environment [10]. Increasing material and energy efficiency in the perfect life cycle is another opportunity for using modular design and design for X from the MC literature to implement CE [10]. Using those practices also enables achieving one of the most important CE principles which are value optimization – circulation of materials, components, and products on a high technological level in the system [10]. In addition, life cycle thinking is included in the business strategy through these practices allowing the assessment of the circularity of a product, its materials, and components as well as calculating its costs, benefits, and risks of extended product life [4; 16].

Build-to-order and postponement are other synergies between the concepts that allow the achievement of materials and energy efficiency due to its concept of starting producing when a customer order is received and delaying important differentiation to the latest possible moment [10].

The platform is another MC practice that is related to the CE practices of dematerializations, the service nature of business models (product-as-a-service), and closed-loop supply chains. Platform thinking is about enabling self-customization and interaction between the company, customers [10], and other value providers [29] and can be used to design/sell new products or even resell and interchange modules [11; 23]. The platforms allow the creation of more value with less or no material through dematerialization [10]. It also enables selling a CE solution in a story when the company has a service nature business model [9] and it allows the operation of closed-loop supply chains through the management of supplier and customers relationship, the connection of the customer demand with reverse logistics and understanding and operating the supply chain in a CE mindset [12; 28]. The concept of platform in the CE context can be perceived as shared platforms such as Spotify and Netflix and as a semi-finished base containing the most shared components within a set of products, that is produced and stocked waiting for the customers personalization order to be finished.

The digital technologies related to the industry 4.0 concepts are considered an enabler for both CE and MC. Technologies such as 3D printing are used in MC as a way to give the customer a unique experience to customize

the product, it makes the production process flexible with lower costs of set up for specific products, and the company as well the customer have the option to choose out of many different qualitative materials [32]. Applied to the CE context, 3D printing demonstrates the high potential to enable product life extension through product redesign, repair, remanufacturing, and upgradability [33], a shift from ownership to service through an innovative business model to achieve higher utilization of products [4] and act as a way to raising awareness about the impact of making things and changing the perceptions about the quality of recycled materials [33]. Besides 3D printing, technologies such as blockchain, Cyber-Physical Systems, and the Internet of Things are used both in MC and CE as a way to make systems and information more reliable and enable continuous communication with customers and stakeholders [31]. Other technologies such as Digital Twins, Artificial Intelligence, and Virtual Reality are also used as an enabler of CE and MC since they can help to achieve the dematerialization principle of CE and enable decision making based on reliable data [34].

Opportunities for CE implementation through MC

Seven opportunities to implement CE through the use of MC concepts were identified through the literature analysis:

Opportunity #1: design and development of products more aligned with customers' needs [7; 8];

Opportunity #2: increasing the awareness of customers and other stakeholders by giving them information about the environmental, social, and economic impacts of the selected features of a given product/solution [7; 12; 21; 30];

Opportunity #3: potential to introduce multiple-life cycles, eco-design, and/or extended the product lifetime [7; 10; 11; 21; 22] through customized products/solutions that fit better to the customer and the use of modular design [7; 11] that facilitates the upgrading and circulation of products, materials, and components [28];

Opportunity #4: introduction of closed-loop supply chains to support multiple life cycles and product, materials, and components re-circulation [28];

Opportunity #5: implementation of product-as-a-service strategies as a way to fulfill customers' needs in a customized way and improve the durability, reparability, and upgradability of products, materials, and components [9; 12];

Opportunity #6: innovation capacity and flexible operations [9];

Opportunity #7: sustainable value co-creation with customers, producers, and other stakeholders that should be involved in the process (e.g.; in the case of a product-as-a-service proposition for example) [23].

Challenges for CE implementation through MC

Five challenges to implementing CE through MC concepts were identified through the literature review results analysis:

Challenge #1: the 'reuse' strategy might seem challenging, because mass customized products are tailored to the individual needs of a respective customer [7; 28];

Challenge #2: the degree to which a mass-customized product is suitable for remanufacturing will be very dependent on how the product architecture is defined [28];

Challenge #3: the variety of parts included in the product may cause some issues if spare parts are necessary [28];

Challenge #4: might be challenging to propose product parts reusability, product, and process platform, and integrated product lifecycle in a way that achieves low costs and high efficiency (material and energy) [27];

Challenge #5: the implementation of MC requires a profound system innovation along the entire value chain and organizational change (to acquire new capabilities) [10; 12].

Conclusions

MC might be an enabler to CE implementation through its opportunities to connect with stakeholders and design products aligned with CE principles using concepts such as modularization and design for X. This paper, through an SLR, identified the 'what we know' about the link between CE and MC. Remarkably, despite the growing

interest of policymakers, academics, and industry in both CE and MC, there was no publication focusing directly on the link between CE and MC, just some publications that briefly cited CE as a consequence of MC or the modularization aspects of MC as a tool to enable circularity in products.

A business that uses MC as a strategy/practice could improve performances in disassembly, maintainability, upgradability, reusability, and recyclability. The inclusion of components with similar characteristics in the same infrastructure module facilitates the achievement of the CE goals and the use of platforms to connect with different stakeholders and mainly the consumers facilitate communication and collaboration. Moreover, the communication between stakeholders allows for creating awareness regarding the sustainability of the product and its features. MC can also increase material and energy efficiency becoming a key part of achieving targets of both energy and resources policies. To make the most of this potential a further and deeper integration of the concepts is required. The use of digital technologies is a powerful enabler of CE implementation through MC and should be more investigated. Moreover, a key issue regarding consumer behavior (essential for CE and MC) is not considered by the publications that are the role of the new generations (Millenials and Z) in the consumption pattern. Those generations are redefining consumption patterns and the companies need to be ready for when they arrive with power in the market and their values determine their buying behavior for more sustainable and/or digital products.

This paper paves the way for several future research opportunities. Among others, the most relevant according to the authors, are:

- When using modularization for MC, a precondition is the standardization of the interfaces, in this sense, who should be responsible for the standardization of these interfaces?
- Is digitalization an enabler or a barrier to using MC for CE implementation?
- What is the impact of the linking between CE and MC on the end-of-life cost? Is it better for the environment?
- How the new generations (Millenial and Z) could impact the implementation of CE and MC?

Finally, learning the right way to fully exploit the benefits of MC from a CE perspective harnessing the experience, at the industrial level, accumulated over the years in other sectors could be a key success factor to develop circular systems.

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APPENDIX I – PAPER 9

Bertassini, A. C., Piller, F.T., & Gerolamo, M. C. (2023). Aligning business model innovation, organizational culture and business ecosystem management for circular economy innovations. IPDMC 2023.

ALIGNING BUSINESS MODEL INNOVATION, ORGANIZATIONAL CULTURE AND BUSINESS ECOSYSTEM FOR CIRCULAR ECONOMY INNOVATIONS

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ABSTRACT

The Circular Economy (CE) promotes systemic strategies to achieve a more sustainable system that holds many innovation challenges, but also opportunities for companies. CE innovation commonly occurs in the business model (BM) level and requires a certain organizational structure and culture, collaboration and active engagement in the business ecosystem (BE). Yet, to date, CE research lacks theoretical and empirical investigations into the alignment between BM, organizational culture (OC), and BE. Business models are, however, highly researched within CE literature while BE and OC are starting to be incorporated into CE literature. The purpose of this paper is to develop a theoretical framework for understanding the dynamic interplay between business model, organizational culture, and business ecosystem management in CE transitions, and identifying the mechanisms and strategies for alignment of the three

concepts. Firstly, we did a literature review to identify relations, mechanisms and strategies. Secondly, we generated practice-based insights, via semi-structured interviews. Theoretical contributions stem from the integration of three concepts into the CE context. Managerial contributions derive from the frameworks that describes how companies align BM, OC and BE management for CE innovations implementation. Furthermore, some challenges related to this alignment were identified. These form the basis for our proposed future research agenda. This research agenda aims to stimulate researchers and practitioners to further demystify innovations towards CE and accelerate the transition process.

KEYWORDS

Circular Economy; Business Model; Organizational Culture; Business Ecosystem.

INTRODUCTION

Environmental and social sustainability concerns have become a major challenge for many industries, from different sectors and countries. Organizations are currently making a move to consider environmental and social issues in their business strategies. For instance, the Circular Economy (CE) emerged as an economic model for sustainable development capable of creating high-quality jobs, raising income, and achieving a truly equitable employment distribution through innovation-driven economic growth (Ho; Chen, 2021; Industrial Development Bureau, 2019). According to the European Comission (2015) the transition towards CE requires gradual changes of established processes and conditions (e.g.; taxation, education, legal framework, finance and funding opportunities, technologies, culture, behaviors) and the general institutional frameworks in the existing economic models over time.

In essence, the aim of moving towards a CE is to slow and close resource cycles to reduce the amounts of natural resources extracted, waste disposed of in landfills, and greenhouse gasses emitted to the atmosphere (Kanda et al., 2021). It is widely spread in the literature and in practice (by political institutions and societal stakeholders) that business models provide a pivotal foundation for transitioning towards CE (Pieroni et al., 2019; Ranta et al., 2018). This is explained with the fact that companies will make critical contributions to CE transition if they implement business models (BM) that make CE economically attractive (Geissdoerfer et al., 2018). In this sense, companies need to propose CE-oriented innovations to explore combinations of product design, business model, and value network configurations to investigate how to operationalize CE strategies (Bocken et al., 2019; de Jesus & Mendonça, 2018) and generate social and environmental value shared among different stakeholders involved in a certain business ecosystem (BE) (Bertassini et al., 2021). CE entails both incremental and radical innovation, however, stopping the depletion of natural resources and reducing current levels of CO2 emissions cannot be achieved by incremental changes alone (Schaltegger et al., 2016). To propose radical CE-oriented innovation in BM, companies need (among other factors) develop a sustainability strategy and organizational culture (CE), and engage and coordinate stakeholders in the business ecosystem (Santa-Maria et al., 2021). However, most companies are still inexperienced in the CE field and do not have these capabilities to operate all the aspects that comprise a viable circular proposition.

CE scholars agree the business model, organization culture and business ecosystem management play a crucial role in moving towards CE. Business models have the potential to deliver environmental sustainability in companies through innovative approaches to creating

and delivering value (Bocken; Boons, 2017). Business model innovation has been shown as a means to integrate CE principles into companies' operations (Chen et al., 2020). Organization Culture ensures that the company has the cognitive frames, shared values and even emotional attachments to organizational identity required to give support to the CE implementation and success in the long-term (Bertassini et al., 2021). Business ecosystems have the potential to guarantee that collaborations and partnerships are developed in order to create a truly circular system that exceeds the organizational boundaries (Parida et al., 2019a). Several frameworks have been created to guide the transition from traditional to circular business models (CBM) (Pieroni et al., 2021; Pigosso; McAloone, 2021); also, there are some researches relating CE with business ecosystem management and/or orchestration (Moggi; Dameri, 2021; Parida et al., 2019b) and organizational culture (Barboza et al., 2022; Bertassini et al., 2021, 2022). Yet, the understanding of how organizational culture, business model and business ecosystem management are aligned/connected to ensure the CE transition is not addressed. Thus, this article aims to develop a theoretical framework for understanding the dynamic interplay between business model, organizational culture, and business ecosystem management in CE transitions, understanding the mechanisms and strategies for alignment of the three concepts.

We carried out a literature review followed by a qualitative analysis to understand the relations of these three concepts already established in the literature. Secondly, we aimed to generate practices-based insights via semi-structured interviews to understand how companies align these three concepts. As main result we identified that business model, organizational culture and business ecosystem management are connected and aligned for CE implementation outlining two ideal factors: processes and stakeholders (people). We can propose that based on the identified mechanisms and strategies that are used by companies (as exposed in literature and by the interviewed experts) which are divided into collaborative innovation, participative governance, and internal processes.

In the next sections we present the theoretical background, the methodology followed to conduct the research, the results and discussions comprehending theoretical and practical implications, and a research agenda, and the conclusions.

Theoretical Background

This section focuses on presenting the main concepts that are in discussion in this research.

Business Model in CE transition

A business model underlying the business logic of a company (Teece, 2010) and explains how the organization does business (Richardson, 2008). A business model oriented towards CE, the so-called CBM can be considered as a strategy to achieve some form of sustainability (Geissdoerfer et al., 2017). CBM is defined as “the rationale of how an organization creates, delivers, and captures value with slowing, closing, or narrowing flows of the resources loops” (Oghazi; Mostaghel, 2018, p. 3). CBMs are micro-level operations that aim to closing product or material loops to keeping resources in use for as long as possible (Kirchherr et al., 2017; Linder; Williander, 2017) through the incorporation of CE principles as guidelines for CBM design (Heyes et al., 2018; Pieroni et al., 2019). The process of propose changes to existing business models or design an entirely new business model is termed as business model innovation (BMI) (Chesbrough, 2010; Massa; Tucci, 2014).

Following the understanding of BMI, according to Guldman; Huulgaard, (2020, p. 3) CBMI – in incumbent companies – “is the process of reconfiguring an existing linear BM to include

CBM components in the form of value recreation, redelivery and recapture and an extended value proposition, or the process of reconfiguring an existing CBM to include more of, or better versions of, these CBM components". CBMI is rooted in radical changes in organization and require collaboration, communication, and coordination within complex networks of interdependent but independent stakeholders (Antikainen; Valkokari, 2016). These kinds of innovations are challenging, disruptive and require changes in the organization as a whole (culture, capabilities, technologies and others).

CBMI are the process by which organizations implement their circular strategies (Bocken et al., 2018; Henry et al., 2020). There are six types of CBM according to BSI (2017): product-as-a-service, circular inputs, sharing, product life extension, resources recovery, virtualization. These types of CBM are the main source of value creation and delivery, and can be seen of two ways: as a vehicle for innovation by connecting innovative products and technologies to bring new ideas in different organizational settings; and as a source of innovation help to transform the existing products and services (Chesbrough, 2010; Massa; Tucci, 2014). A company that incorporate the principles of the CE can present one or a mix of several of these CBM because each CBM is related to one part of the circular value chain as presented by (Arponen et al., 2018): circular supply chain (circular inputs) is related to the sourcing, manufacturing and logistics; sharing is related to marketing & sales, and product use; product life extension is related to product use and end of life disposal; recovery & recycling (resources recovery) is related to reverse logistics to close the loop; and product-as-a-service is related to all the value circular value chain processes.

Despite the recent efforts on CE transition rely on business model innovation; this view should be extended to consider the CBMI that other stakeholders on the ecosystem are doing. According to Manninen et al., (2018) individual firm's business model has difficulties to reach systemic and effective changes. Thus, the perspective of business model should be extended to incorporate alignment of stakeholders across the ecosystem (Parida et al., 2019a).

Business Ecosystem management in CE transition

Business ecosystem is a value-oriented network whose support different stakeholders and the transaction among them (Adner; Kapoor, 2009). Parida et al., (2019a) affirm that the ecosystem perspective explains the CE transition in a system level, because in this logic companies co-evolve cooperatively and competitively around interactions while redefine their business capabilities (Jacobides et al., 2018; Moore, 1993). The business ecosystem could be performed in three ways: innovation, service and platform ecosystems (Fuller et al., 2019; Jacobides et al., 2018; Konietzko et al., 2019).

Innovation ecosystems describe how legally independent stakeholders create shared value with joint efforts (Adner, 2006; Dedehary et al., 2018). De Vasconcelos Gomes et al., (2018) affirms that the innovation ecosystems are directly related to the creation of value that will be further captured in a business ecosystem. A service ecosystem, on the other hand, is based on the idea of value co-creation in a service-dominant logic (Aminoff et al., 2016; Smith et al., 2014). The service ecosystem perspective highlights the role of institutional complexities (rules, norms, values beliefs) and institutional arrangements connected in a collaborative relationship to co-create value (Koskela-Huotari et al., 2016; Vargo; Lusch, 2016). A platform ecosystem is the form how stakeholders organize themselves around common technological and/or market-

oriented platforms (Jacobides et al., 2018). According to de Vasconcelos Gomes et al., (2018) platforms could facilitate innovations and help to manage complexities.

In a business ecosystem the way a specific stakeholder, relate with the whole, and vice-versa, change to achieve a common and desired outcome developing co-specialized and complementary products and services that are more valuable when combined (Fuller et al., 2019; Jacobides et al., 2018). To be part of or orchestrate a circular BE, organizations should be open to change and accept failure as a means to learn and improve the innovative solutions. Moreover, new skills and capabilities should be developed to support the culture and the relationships performed in the ecosystem (Smith, 2006). For Konietzko et al., (2020) the companies in a circular business ecosystem should discover how to an offer complement other products and services that when combined may provide a superior and circular value proposition.

For a CE transition, the management of BE and development of collaborative relations between stakeholders are extremely important as highlighted by Fehrer; Wieland (2021) when they affirm that while single actors such as social entrepreneurs, powerful incumbent firms, or social activists are important, they cannot drive institutional change in isolation.

Organizational Culture in CE transition

One frequently cited definition from organizational culture is Schein, (1996, p. 3): "organizational culture is the pattern of basic assumptions that a given group has invented, discovered, or developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid, and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems". Organizational culture is a variable associated with various organizational outcomes and is a root metaphor for conceptualizing organization" (Smircich, 1983, p. 342).

An organizational culture focused on sustainability is an organization where members have common beliefs and opinions about the importance of balancing economic efficiency, social equity and environmental responsibility that are guiding managers and employees in their behaviours and decision-making process (Paraschiv et al., 2012). The OC reflects the values, norms, rules, procedures, organizational goals (Jones, 2013), and the sense of identity shared between the employees (Cameron & Quinn, 2011). OC reflects what an organization is (Smircich, 1983) and has the power to foster or hinder innovations (Schein, 1984). An OC focused on CE is an organization where all members have common and shared values, mindsets, and beliefs about the importance of creating and delivering positive values for all the ecosystem stakeholders.

OC for the CE is recent in the literature and according to Bertassini et al. (2021a), a CE-oriented culture is represented by five building blocks namely mindsets, values, behaviors, capabilities, and competences, that are dynamically linked. Mindsets are rooted in values. Values are translated into behaviors. Behaviors are executed when combined with the right capabilities. Capabilities become competences when they are supported by attitudes. These building blocks represent the soft and hard aspects that are relevant for organizations to promote changes. According to Bertassini et al. (2021a): values are criteria, patterns, or directional principles that are related to the future state of a circular organization; mindsets are beliefs or mental attitudes aligned with CE principles and values that determine how the organization will interpret and respond to situations; behaviors describe how people and organizations act in the CE transition;

capabilities describe the right theoretical knowledge on CE concepts (qualification) with the ability to perform these concepts (know how to do); and competences describe the combination of the capabilities implemented repeatedly with the attitudes to implement these capabilities (know how to behave).

METHODOLOGY

Given the exploratory nature of this research, a systematic literature review combined with interviews with field experts was chosen as the methods used in this research.

Systematic Literature Review

An SLR is a type of scientific investigation that aims to critically evaluate and perform a synthesis of results on multiple studies (Cook et al., 1997). The SLR ensures an evidence-based, unbiased management of knowledge (Tranfield et al., 2003) and it is defined as "a form of secondary study that uses a well-defined methodology to identify, analyze and interpret all available evidence related to a specific question in a way that is unbiased and repeatable" (Kitchenham, 2004). In this sense, we carried out the searches in the databases Web of Science and Scopus using the string *((("circular economy" OR "circular business model" OR "circular business model innovation") AND ("organi*ational culture" OR "organi*ational behavio*r" OR "organi*ational mindset") AND ("business ecosystem" OR "ecosystem" OR "innovation ecosystem")))*. Applying this string we had only two publications in return. Then, due to the scarce number of publications directly combining the constructs we tested other strings and expanded the search to another database (EBSCO). Three more string were tested: (i) *(("circular economy") and ("organi*ational culture" or "organi*ational behavio*r" or "organi*ational mindset"));* (ii) *(("circular economy") and ("business model" or "business model innovation"))*; and (iii) *(("circular economy") and ("business ecosystem" or "innovation ecosystem")).* These strings returned, respectively, 56, 1544 and 66 publications considering the results obtained from the three databases (Web of Science, Scopus and EBSCO) without eliminating the duplicated ones. Thus, it is clear that the three concepts of business model, organizational culture and ecosystem management in the CE innovation context are not applied/studies together (at least not using those specific words).

We passed the resulting publications from the databases through some screening filters as shown in Table 1. We selected 19 publications to carry out a deeper analysis and extract some clear or hidden relations discussed about the alignment between BM, OC and BE management for CE innovation. Through a content analysis of these publications, we identified some three mechanisms and related strategies that can be used to align those concepts when implementing CE innovations.

Table 1: Systematic Literature Review screening

Strings	Scopus	WoS	EBSCO
(("circular economy") and ("organi*ational culture" or "organi*ational behavio*r" or "organi*ational mindset"))	20	21	15
(("circular economy") and ("business model" or "business model innovation"))	917	546	81
(("circular economy") and ("business ecosystem" or "innovation ecosystem"))	32	24	10
Total		1665	
Duplicated		542	
Total		1123	

Filter 1 – title, abstract, keywords	545
Filter 2 – introduction and conclusion	204
Filter 3 – complete reading/analysis	19

Experts' Interview

Some open-ended questions were prepared in advance as a guide to conduct the interview. Leading experts in CE and/or innovation from companies in Brazil and in Germany were selected for participation as purposive sampling. Rubin and Rubin (2011) suggested guidelines for selecting samplings purposively by focusing on subjects who are knowledgeable about the experience being studied, willing to talk, and can address a wide range of perspectives. Seven experts participated in the interviews. The rational criteria for selecting those experts were the reputation and knowledge/experience in sustainability implementation through CE and innovation; and knowledge/experience in innovation management as a whole. The characteristics of the experts can be seen in Table 2.

Table 2: Experts detail

Expert	Position	Company	Experience
A	Founder & CEO	Alpha – CE and Sustainability Consultancy	11 years (CE/sustainability)
B	Executive Manager for Carbon Initiatives	Beta – Paper and Pulp	30 years (CE/sustainability)
C	Head of Sustainability and EH&S	Gamma – Engineering and Technology	17 years (CE/sustainability)
D	SGI Manager	Delta – Paper and Pulp	20 years (CE/sustainability)
E	Sustainability Consultant	Epsilon – Paper Manufacturer	5 years (CE/sustainability)
F	Founder & CEO	Zeta – Recycling and Remanufacturing	19 years (CE/sustainability and Innovation)
G	Co-Founder & CEO	Theta – Fashion and Textile	5 years (CE/sustainability)

The interviews were set up by appointment email asking for an online interview whose date and time depended on the availability of the expert. The proposed time for the interview was about an hour in consideration of a reasonable maximum length for semi structured interviews to minimize fatigue for both interviewer and respondent, as suggested by Adams (2015). The interview provided an opportunity for the experts to share their knowledge on working towards innovation, circular economy and sustainability in the different companies that they worked for during their professional life. The participants' responses and reflections were recorded and then produced into a transcript. Thematic analysis was applied to analyze the data gained from the participants' opinions, knowledge, and working experiences. The thematic analysis focuses on themes and patterns of living and/or behavior that can be identified (Aronson, 1995). From the transcribed conversations, we could confirm the proposed mechanisms and strategies based on the practices-based insights used to align business model, organizational culture and business ecosystem management to innovate towards CE. Direct quotes were used along the results and discussions section to shared common ideas.

RESULTS AND DISCUSSION

This section focuses on presenting the findings that emerges through the SLR and interview analysis. We first broadly characterize the main challenges faced by companies to implement CE-oriented innovations. Then, we present the mechanisms and strategies underpinning the alignment of business model, organizational culture, and business ecosystem management to

circular innovation, namely, (i) collaborative innovation, (ii) participative governance, and (iii) internal processes. These mechanisms and strategies were derived from the content analysis, while some explanations that follows is guided by the results from the expert interviews. In addition, we proposed a theoretical framework for understanding the dynamic interplay between business model, organizational culture, and business ecosystem management in CE transitions.

Challenges for CE-oriented innovation implementation

The findings demonstrate that key challenges tend to center on the lack of the right mindset/culture for CE transition, lack of leadership/decision-makers engagement, and on the difficulty to engage stakeholders at the ecosystem level. On the contrary, commonly discussed operational challenges (e.g., lack of technology) are not perceived anymore as unsolvable (Averina et al., 2022).

Regarding the right mindset/culture for CE transition, we identified some key challenges associated: lack of awareness of CE (Yamoah et al., 2022); misalignment between values and beliefs of business executives and the circularity values and goals of their organizations (Yamoah et al., 2022; Kuhlmann et al., 2022); lack of information or awareness of what CE was internally within the organization (Yamoah et al., 2022; Klein et al., 2022); the internal organization pressures, the time required, and the associated commitments in terms of reorganizing ways of working are also challenges of CE implementation (Yamoah et al., 2022); people are not unwilling to embrace CE practices because CE is not considered as a priority for the organization (Klein et al., 2022); the lack of a deliberate, organizationally embedded strategy and processes for circular innovation (Kuhlmann et al., 2022).

In respect to the lack of leadership/decision-makers engagement we found that the challenges are: business leaders (whose reservations were rooted in a perception of high risk associated with pursuing sustainability opportunities) are not persuaded by the short-to medium-term business case for CE, financial viability of the project and the likelihood of realization (Yamoah et al., 2022; Averina et al., 2022); top management commitment and willingness to engage with the CE debate and discourse has the power to promote or inhibit finding holistic solutions and strategies for the adoption and success of a circular business model (Pheifer, 2017); managers feel conflicting priorities about and a general reluctance to adopt CE at the expense of profits (Yamoah et al., 2022); managers feel a lack of direct benefits in pursuing a CE based on the fact that the benefits were either too difficult to measure or were overtly intangible (Yamoah et al., 2022); leadership efforts fail to make employees understand the importance of CE practices in their day-to-day life in the workplace (Klein et al., 2022); managerial resources represented a hurdle and sometimes executives were not trained in managing uncertain, potentially high-growth projects, and the prevailing incentive system made employees hesitant to bet on innovations (Kuhlmann et al., 2022).

Regarding the difficulty to engage stakeholders at the ecosystem level the challenges are: misaligned values and beliefs inhibit relevant stakeholders engagement for transitions to a CE with responsibility shifted to civil society and public institutions (Yamoah et al., 2022); lack of collective disposition to foster collaboration with sectoral and supply chain partners to engender circularity transitions due to the absence of standard systems for CE performance indicator (Yamoah et al., 2022); and lack of partner incentives when compared with required commitments and an unclear leadership or governance model (Averina et al., 2022).

According to our findings, the above-mentioned problems and uncertainties could be addressed or ameliorated if companies had a clear vision of the need and how to align the main 'aspects' required for CE implementation in the ecosystem level, that is: business model, organizational culture and business ecosystem management.

Mechanisms and Strategies for BM, OC and BE management alignment for CE transition

As Expert F said "*organizational culture, business model and ecosystem, if they are not aligned is a factor that hinders the implementation of CE*". Thus, it is essential to having mechanisms and strategies that enables the alignment of this three concepts of CE transition. Table 3 presents the mechanisms and strategies that underpinned the alignment between business model, organizational culture, and business ecosystem management for CE transition.

The first mechanism is collaborative innovation, which involves actions of collective learning and collaborative processes to enhance circular value co-creation by combining expertise, capabilities, and resources of the participating organizations and individuals (Brown et al., 2021). This mechanism aggregates seven strategies. (I) Systemic alignment to innovate towards CE that reflects the need to collaborate for successful CE transition. According to Fehrer; Wieland (2021), no single actor can drive institutional change and innovative business models in isolation which is the case of CE-oriented innovations. Moreover, the systemic alignment processes that shape business models for CE can only be understood when viewed from various system levels (e.g., micro, meso and macro) (Brown et al., 2021; Fehrer; Wieland, 2021). (II) Establish new alliances and/or improving existing ones with key and suitable partners refers to the need to involve the right people focus on circular vision and motivations. The aim is to source complementary capabilities, competences and resources to strengthen collaborations (Brown et al., 2021; Kuhlmann et al., 2022). A key managerial consideration is that CE requires radical and systemic innovations based on a more networked approach to explore complementary innovations and business models, greater tolerance for risk and expands the scope of collaboration beyond existing relationships to explore increasing sustainable impacts (Adams et al., 2016; Brown et al, 2019, 2020; Pollard et al., 2021). Moreover, promoting multidisciplinary environment are also valuable for BE participants work collaboratively on social impact, improve sustainability performance and partner up with other industries (Suppipat; Hu, 2022). (III) Align individual and shared interests ensures that the partners in a project work towards the same goals, have a shared vision and understanding of key concepts (Brown et al., 2021; Konietzko et al., 2020). (IV) Redefine actor roles and responsibilities to make sure that the participants understand their roles in a circular ecosystem (Konietzko et al., 2020). Clear roles can prevent misplaced expectations and guarantee a good management of the BE. It is important to note that the roles and responsibilities may change over time, therefore, may be needed to continuously redefine them. (V) Address partnerships' cultural issues that would encourage CE business models to be widely adopted (Pollard et al., 2021). It is worth to understand how appealing the CE benefits are to the BE actors, which can be determined by the fit between the CE implementation outcomes and the sustainability related goals of ecosystem partners and customers (Averina et al., 2022). (VI) Establish engaging relationships based on listening and dialogue ensures active participation of relevant stakeholders as well as the establishment of long-term relationships between them and the company (Salvioni; Almici, 2020). (VII) Establish and maintain trust is important to keep partners motivated over time,

ensure that they pursue similar strategies and goals (Konietzko et al., 2020); behave according to expectations, act fairly and fulfill obligations (Brown et al., 2021).

Table 3 - Mechanisms and Strategies

Mechanisms	Strategies	Authors
Collaborative Innovation	Systemic alignment to innovate towards CE	
	Establish new alliances and/or improving existing ones with key and suitable partners	
	Align individual and shared interests	
	Redefine actor roles and responsibilities	
	Address partnerships' cultural issues	
	Establish engaging relationships based on listening and dialogue	
	Establish and maintain trust	
Participative governance	Develop circular oriented-decision making	
	Creation of standards/public policies	
	Establish an orchestrator	
	Form a shared vision around how to operate in the circular paradigm	
	Communicate	
Internal Processes	Integrate CE practices in strategic plans, policies and programmes	
	Establish CE champions amongst employees and managers	
	Establish working groups on organizational CE issues	
	Recruit experts to work on CE/sustainability	
	Create a separate entity for the circular innovation	
	Reviewing the compatibility of the competencies required with those available internally and externally	
	Align the business model innovation process with the ongoing dynamics on the regime level	
	Develop a circular oriented value capture model	
	Co-design business models with stakeholders	
	Clear senior management commitment to sustainability	
	Circularity education and training	
	Develop and use indicator system to measure organizational CE performance	

The importance and the challenge of the collaborative innovation mechanism was placed by Expert B: *"when we talk about ecosystem, you are bringing some stakeholders there, some responsible for that stage of the value chain that are not necessarily exclusive to your business. So, attracting the right level of interest or commitment is a great challenge, in addition to*

having all this aligned 100% with the value chain. Many times, you get commitment and you get time. You get dedication from people, sincere contributions from those parties. I think like aspiration. It's interesting that you try to put it all together, but I see it as a beautiful challenge to bring together the economy, circulate the business model and align it with the entire ecosystem".

The second mechanism is participative governance which refers to existence of a governance system that integrate all the actors from the BE ecosystem in order to ensure a good functioning and successful implementation of CE-oriented innovations (Moggi; Dameri, 2021). This mechanism comprehends five strategies. (I) Develop circular oriented decision-making that can range from unspoken or emergent norms and values to formalized rules defined in documents, agreements or contracts (Brown et al., 2021) which creates a sense of trust and belonging (Moggi; Dameri, 2021). Moreover, this strategy also includes the need of organized and co-creative processes to build shared meaning and understanding of the systemic problem and the solution space (Konietzko et al., 2020). (II) Creation of standards/public policies refers to the need of stakeholders engage in dialogue with government agencies to expedite the drive towards a collective CE consensus and uptake (Yamoah et al., 2022). According to Yamoah et al., (2022), changes led by civil society through the use of education will be much slower and more difficult compared to those led by public institutions through regulatory compliance. In this context of standards and public policies, Expert C affirmed that *"the country's culture is an obstacle to the circular economy. For example, currently, Brazil, it kind of penalizes companies that want to opt for circular models because the country does not have public policies and legislative and fiscal incentives for that".* (III) Establish an orchestrator is needed to lead and bring clarity to the roles and responsibilities of actors (Averina et al., 2022), share a common vision and build trust, on the commitment of resources and on the transformational leadership of its key decision makers (Zucchella; Previtali, 2019). Digital and shared platforms can be used as tool to orchestrate BE (Blackburn et al., 2022). (IV) Form a shared vision around how to operate in the circular paradigm throughout the articulation of a vision that embraces the views of different stakeholders (Blomsma et al., 2023; Bocken; Konietzko, 2022). (V) Communicate in order to maintain the transparency about the actions taken towards CE transition, this can be done by organizing conferences and events to disseminate updated knowledge and practices (Brown et al., 2021), and by publishing reports on CE organizational performance (Klein et al., 2022). Communicate here can also act as tool to change consumer consumption mindset because as said by Expert D *"education of consumption is essential. The company can make the most environmentally friendly image possible, if it doesn't have the educational part, consumer awareness, it won't help".*

The third mechanism is internal processes which refers to need to reconfiguring internal processes regarding the value creation, delivery and capture element that is crucial in managing the transition towards circular business models (Palmié et al., 2021). This mechanism comprehends twelve strategies. (I) Integrate CE practices in strategic plans, policies and programs including targets and guidelines on rules of procedures is essential to make CE part of the culture (Klein et al., 2022). (II) Establish CE champions amongst employees and managers to act as the agents of change and to be the focal point responsible to implement, collect and report CE practices (Klein et al., 2022). (III) Establish working groups on organizational CE issues is complementary to the strategy (II) and it important to ensures the dissemination of the CE culture through the company and the BE (Klein et al., 2022). (IV) Recruit experts to work on CE/sustainability sometimes is an alternative to companies that are

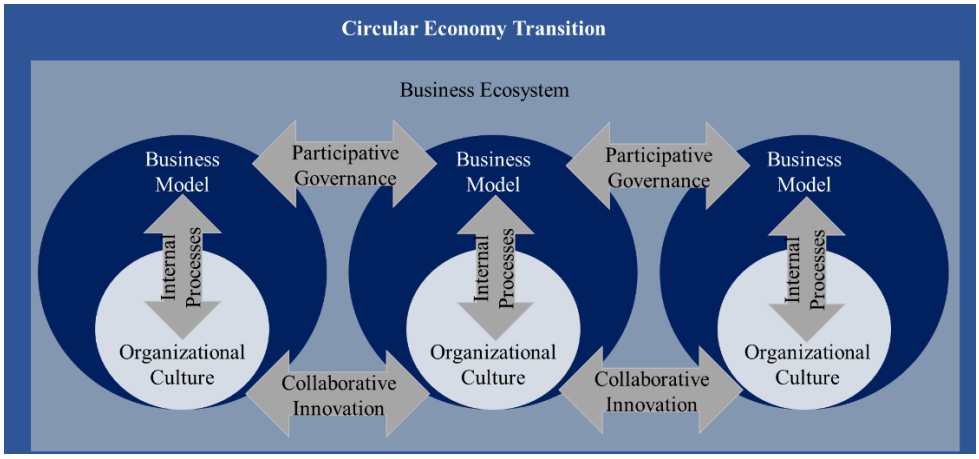
suffering with resistance to change towards CE innovations and/or that lack the knowledge to implement circular business models internally and to engage in BE actions (Klein et al., 2022). (V) Create a separate entity for the circular innovation is one of the best strategies to implement CE in incumbent firms where usually there is a lot of challenges (cultural and technical) to propose CE innovations (Kuhlmann et al., 2022; Blomsma et al., 2023). A separate business unity focused only on CE-oriented innovation gives the freedom for the proposition of radical and systemic solutions in the same time that there is all the technology and resources from the already established firm that can be shared. For companies that are born with a CE DNA it is much easier because as expressed by Expert H "the mindset that the company started with is already circular, so they don't need to align their processes because when something new is done it is already circular. That's the mindset before they start something". (VI) Reviewing the compatibility of the competencies required with those available internally and externally deals with evaluating the possibility of a required upgrade or development internally or by existing or new partners (Averina et al., 2022). (VII) Align the business model innovation process with the ongoing dynamics on the regime level refers to the need of companies to have a long-term view and a broad vision of what is going on outside the organization's boundaries (Gorissen et al., 2016). (VIII) Develop a circular oriented value capture model that is focused on collective outcomes across multiple lifecycles to ensure that all the stakeholders involved in the BE are contemplated with the values created by CE-oriented innovations implementation (Brown et al., 2021). (IX) Co-design business models with stakeholders to strengthening the efforts of the stakeholders in their pursuit of the ecosystem value proposition while simultaneously providing benefits to those who shared their resources (Moggi; Dameri, 2021). (X) Clear senior management commitment to sustainability to ensure that the leadership is aligned with CE values and mindset and guarantee the willingness to implement CE innovations (Brown et al., 2021; Barford; Ahmad, 2022; Arekrans et al., 2023). (XI) Circularity education and training play a positive role in changing negative assumptions including promotion of managers' engagement with other relevant stakeholders to build synergies and strategies for CE systems (Yamoah et al., 2022; Klein et al., 2022). Offering training and undertaking awareness campaigns may allow stakeholders in the organization to transition from an 'invisible organizational culture', where incorrect notions held by stakeholders may be less likely to be challenged, towards a more 'visible' and transparent culture and perception. The measure and quality of knowledge on circularity determines the number and types of CE strategies and practices implemented by organizations, which is reflected in their actions and behaviours (Yamoah et al., 2022). (XII) Develop and use indicator system to measure organizational CE performance ensures the level of adoption of CE internally and in the BE level (Klein et al., 2022).

Shortly, we can affirm that business model, organizational culture and business ecosystem management are connected and aligned for CE implementation outlining two ideal factors: processes and stakeholders (people). Processes referring to the existence of all the right structural and technical aspects required for innovation towards CE. Stakeholder (people) referring to the need of the right people and partners to put in operation all the structural and technical capabilities and competences. This was confirmed by Expert A: *"Culture is important. Business Model is important. Ecosystem is important. What is lacking today, which connects and makes things aligned, are the processes. I will have the culture, for the culture I need people. For processes you don't need people. The process is outlined there. But people and culture go together. People build the culture. So, you will have people there, a culture; if*

you have processes, in the process you will have a tool, procedure and so on. Then people will be able to move forward, in the sense of developing the solution, testing, prototyping, validating the business model, putting it on the market, in short, to be able to develop the business model, and work with this ecosystem vision. So, I think the way to be aligned is to have processes that will connect the company and make the culture, people and what they do, become a circular ecosystem. The most classic example is the design process. There is eco-design working there, there is a culture of innovation and competence of people in this process who will develop more sustainable products that at one time or another will connect with the ecosystem, and can connect with a new business model. For example, PSS model. Strategic planning, even if it is a process, which defines the area of action, goals, challenges, etc. I'm going to put a vision of the future there and that will naturally make people seek to build the solution, and sometimes, that vision of the future is the business model and the ecosystem."

Figure 1 presents the theoretical framework comprehending the key aspects (business model, organizational culture and business ecosystem) and alignment mechanisms required for the transition towards CE innovation. A company oriented towards CE has a specific CBM or a mix of different CBM that represents that the forms of value proposition, value creation and delivery, and value capture followed by the company. Part of the CBM chosen by the company is due to the company strategy and organizational culture, and connecting the BM and OC there the internal processes of the company that is the responsible for this alignment. An individual company, should interact to other individual companies in order to successfully implement a circular system. The collaboration between these companies forms a circular BE, where participative governance and collaborative innovation are requirements for the alignment. The circular BE has a culture, different from the organizational culture of each individual company, that is shared between all the ecosystem players and that gives the support to make all CE strategies and changes happen. According to Expert E *"organizational culture is something alive, it's something organic. It moves over time, even though it maintains a much stronger historical and conceptual core. This culture responds to some stimuli as these issues are worked on in the context of organization or the ecosystem. […] I would also say that you have a nucleus there a little more common and that perhaps characterizes a more unconscious part of the culture. But when we see these elements of the circular economy, we have some issues that are managed and others that are not. I think it imposes itself, so it is it is necessary for the company and ecosystem to work in collaboration in a fluid movement."*

Figure 1: Theoretical Framework



Theoretical and Managerial Implications

This study, which used a qualitative approach to explore the underlying mechanisms and strategies used to align BM, OC and BE; and challenges faced by companies to implement CE in the cultural and ecosystem level. Specifically, there is a perception expressed by companies' leaders and registered in literature that CE is not capable of driving socio-economic growth or improving business competitiveness. This misconception seems to be related to the difficulties of leaders with measuring and understanding the long-term economic benefits of CE innovations. The study also revealed that the key challenges underlying the slow-paced change towards CE innovations that is the lack of the right mindset/culture for CE transition, lack of leadership/decision-makers engagement, and on the difficulty to engage stakeholders at the ecosystem level.

More specifically, this study contributes to knowledge and insights on the corporate mechanisms and strategies that enables the alignment between BM, OC and BE; and challenges that hinder CE innovation adoption. The collective understanding from this study serves to rebalance existing circularity knowledge between management scholarship. This balance represents a critical equilibrium required to engender a paradigm shift (Korhonen et al., 2018) toward a CBM. Among other findings, the challenges regarding CE implementation, and the mechanisms and strategies used to align BM, OC and BE provide avenues for targeted interventions to mainstream a CE framework. Acting appropriately on these findings will enable decision-makers to understand the value of CE and encourage a multi-stakeholder approach to promote its adoption and explore its strategic business advantage.

Moreover, this study offers recommendations to the senior management of incumbent firms who are visioning the CE transition, driving the sustainability agenda, and initiating CBM projects and that are having problems in sustain or expand CE innovations. More specifically, we provide hands-on advice on how companies can align business model, organizational culture and business ecosystem management for circular economy innovations implementation. The three mechanisms and its respective strategies that we proposed guide companies in the alignment process for CE-oriented innovation propositions and implementation.

Research Agenda

As a result of the findings and discussions, this research further recommends the following four research propositions be explored in future research:

I. CE innovations will only begin to resonate positively with private organizations and business when a convincing short- to medium-term business case is presented and leaders are convinced about the long-term benefits of CBM;
II. A better alignment between individual and organizational values and beliefs towards CE implementation will activate a shift towards re-aligning business leaders' values and beliefs with organizational goals for a CE;
III. Understanding how to effectively engage employees and BE partners in move towards CE;
IV. Collective disposition to collaborate in the ecosystem level and the presence of standards system for CE benefits measurement also in the ecosystem level are essential to be understood for CE innovations implementation.

CONCLUDING REMARKS

Overall, this paper has aimed to advance the CE literature by demonstrating how business model, organizational culture and business ecosystem can be aligned. Based on a qualitative study, we identified three key mechanism and twenty-four strategies that underpin the alignment of BM, OC, and BE management for CE innovation. The findings are relevant to large incumbent companies and their ecosystem partners undergoing circular transition. They assist in proactively foster CE transition through the alignment of essential aspects of organizational changes that circular innovation. The framework does not directly guarantee success in CE-oriented innovation since making the transition to circularity will continue to heavily depend on a variety of internal and external contingencies, such as leadership commitment, supportive legislation, and surrounding infrastructure (Moktadir et al., 2020). However, engaging in alignment with BM, OC and BE can help companies to proactively learn about the key issues influencing circularity efforts and address or mitigate them in due course. This, in turn, will ease a firm's access to the CE and improve the chances of a successful outcome both for the focal firm and for the environment and society as a whole.

Although the present study provides numerous theoretical and managerial implications, these need to be interpreted in the light of certain limitations. Firstly, although this study is based on a literature and managerial gap; our limitations lay in need of more exploratory research with companies from different countries, sectors and business models. Secondly, generalizing our findings is limited since we just investigated already existed literature and consulted a limited sample of experts.

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APPENDIX J – Semi-structured interview questions

1. For how many years have you been working with circular economy/sustainability?
2. Tell me about the companies you already worked. Could you share some examples related to CE/sustainability implementation which you are proud of?
3. Tell me about the concrete steps/activities and with whom you worked (partners other business ecosystem players) to implement CE/sustainability in the companies that you worked.
4. What kind of management structure (process, good practices, tools, metrics) the companies that you worked developed/used to implement CE/sustainability?
5. From your experience, do you think that change from a mindset centered in the organization to a mindset focused on the business ecosystem/stakeholders can facilitate the implementation of CE? Why?
6. From your experience, what cultural aspects would be most important for the organization have/be part of a circular system?
7. From your experience, how was the role of leadership in implement CE/sustainability?
8. How the companies you worked for did to engage all the important players (internal and external) in the proposition and implementation of CE/sustainability initiatives?
9. Could you describe issues that either enhanced or complicated the adoption of circular initiatives and the achievement of CE goals in the companies that you worked?
10. Do you think that organization culture, business model and business ecosystem are important for CE implementation? If yes, how would you align them to implement circular economy?
11. Do you have in mind someone to recommend for us to interview (in your company or of other companies)?