


RESEARCH ARTICLE

Circular business models and the environment: Maturity levels of the circular economy and innovation in greener craft breweries

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Abstract

This article aims to highlight the level of maturity of the circular economy according to the ReSOLVE framework, the level of maturity of technical and biological cycles, and the level of maturity of sustaining and disruptive innovation in Brazilian and Portuguese craft brewing companies. Through a multiple case study in the craft brewery sector in the state of Santa Catarina (Brazil) and in the city of Porto (Portugal), a qualitative study was developed by means of a documentary analysis of secondary data, technical visits, and application of on-site interviews with 11 Brazilian and 11 Portuguese companies. The results indicate that (I) Brazilian and Portuguese companies are at different maturity levels concerning the circular economy, according to the ReSOLVE framework; (II) the maturity levels of the technical and biological cycles can be identified in the recycling practices of both cases, with the 11 Portuguese companies operating at the optimized level while the Brazilian companies are moving toward optimization; and (III) regarding innovation maturity levels, sustaining innovation is incorporated and optimized in these 22 companies. Concerning disruptive innovations, the results show that Brazilian and Portuguese companies are at different stages. This study contributes to theory by linking circular economy constructs and innovation and introducing gastronomy as a new link between these constructs. For practitioners, it highlights the stages of maturity and practical actions that can guide the improvement of maturity levels. In terms of limitations, we cite the geography and population of the countries and states addressed, the pandemic, differing production volume between companies, and the scope of the businesses. We suggest that future studies replicate or expand the sample to other geographic regions, as well as apply the framework to other business segments.

KEYWORDS

circular business models, circular economy, craft brewery, environmental maturity levels, sustaining and disruptive innovation

1 | INTRODUCTION

A business model comprises the activities carried out by a company, business guidance, and corporate conduct (Aagaard & Nielsen, 2021). Circular business models (Sehnm et al., 2021) are business models designed to encourage the reuse of products so that companies can enjoy several benefits, such as improved relationships with customers, suppliers, and partners; meeting market demands faster and more assertively; and creation of competitive advantage (Sehnm et al., 2022) providing greater added value to the brand, as well as moving ahead of current legislation in order to reduce business risks related to the future scarcity of resources (Santa-Maria et al., 2021).

The circular economy is an area into which companies are currently entering in order to do business in a smart, sustainable, and profitable way and is perceived as an alternative approach that encourages the reuse of materials in new products (Weetman, 2019). The circular economy, viewed in terms of the practices of the ReSOLVE framework ("Re," Regenerate; "S," Share; "O," Optimize; "L," Loop; "V," Virtualize; "E," Exchange), can generate positive impacts through improvements in technical and biological cycles and benefits for the business model via the generation of increased profit (Pieroni et al., 2019).

Innovation is understood as the adoption, assimilation, and exploitation of value-added novelty that generates renewal and continuous improvement in products, processes, services, and markets (Lee & Trimi, 2021). Christensen (1997) highlighted two types of innovation: sustaining and disruptive. Sustaining innovation occurs when companies take a chance on product or service improvements to reaffirm their leadership; disruptive innovation occurs when companies innovate using a product or service technology with disruptive instead of evolutionary characteristics, provoking a rupture with the standards already established in the market, leading to an unprecedented, original, and transformative situation.

Maturity levels refer to the evolutionary stages of developments in a company, providing a clear definition of the objectives of the company's processes. They provide prerequisites for improvements to be made and can guide the growing capacity of organizational processes (Geisendorf & Pietrulla, 2017). In the circular economy and in technical and biological cycles, the relevant levels range from zero (0) to five (5), with zero (0) meaning non-existent, one (1) executed, two (2) managed, three (3) established, four (4) predictable, and five (5) optimized (Grant & Pennypacker, 2006). Innovation maturity levels provide insights into the ability to demonstrate improvements in the company's innovation journey and also range from one (1) to five (5), with one (1) meaning awareness, two (2) defined, three (3) linked, four (4) managed, and five (5) sustained (McCormack et al., 2008).

Beer is a beverage obtained through the alcoholic fermentation of brewer's wort, made from barley malt and drinking water, by the action of yeast, with the addition of hops. Artisanal brewing refers to a gastronomic product produced by a family-owned business, using the same components as a traditional brewery but focusing on creating a variety of colors, aromas, and flavors while making use of traditional recipes (formulas) (Associação Brasileira de Cerveja

Artesanal, 2020). Craft breweries are currently associated with representativeness and exponential growth, which the sector is achieving in Brazil and Portugal. The cold beverage industry in Brazil, of which the brewing sector forms part, is representative, and the country is the third largest producer of beer in the world, which can be directly correlated with the progress and development of the country's economy. This industry is present in all cities across the country and encompasses a network of industries that range from agribusiness to small retail via the packaging, machinery and equipment, and logistics markets (Associação Brasileira da Indústria da Cerveja, 2020). In Portugal, the industry promotes hospitality and is an important source of jobs for young people; this market is currently expanding and is driven by a trend toward sensory experiences (Aquino & Quaresma, 2019). This market highlights consumers' search for pleasure in consumption, in addition to developing a network of input suppliers and promoting national events, parties, and competitions (Europe Economics, 2020).

In order to understand how circular economy principles and practices develop and perform, it is necessary to investigate how circular business models are implemented in companies (Brown et al., 2020). It is at this point that the scientific literature opens up a range of research strands and studies that aim to create, deliver, and capture value through the implementation of circular business models, driven by sustaining and disruptive innovations, which have not yet been fully mapped. For this study, the Scopus, Web of Science, Ebsco, Proquest, Science Direct, Spell, Emerald, Sage, and Wiley Online Library databases were consulted. As a subject of relatively recent development, the circular economy has generated interest from the public and private sectors, as well as scholars and researchers, covering a diverse range of tangential and related discussions on the subject (Baldassarre et al., 2019; Ellen MacArthur Foundation, 2015; Grillitsch et al., 2018; Sarasini & Linder, 2018). Thus, companies need to adapt their business models to fit this new approach (Ünal & Shao, 2018; Mokhtar et al., 2019) and must consider their current level of technological development, which must be mature enough to support the implementation of circular economy principles and practices (Heyes et al., 2018; Parida et al., 2019). Alternatively, new companies may be created with circular business models (Bocken, Mugge, et al., 2018; Whalen et al., 2018) and thus adopt sustaining and disruptive innovation (Riesmeier, 2020) to generate opportunities to create, deliver, and capture value (Chen et al., 2019; Lacy et al., 2020; Parida et al., 2019).

Innovation is discussed widely among business model practitioners and adopters (Lacy et al., 2020) as well as academic researchers (Christensen et al., 2015, 2016). Innovations can generate important contributions to clarify underlying constructs, such as which sustainable operations are implemented, how companies use the ReSOLVE framework, how the implementation of the circular economy in business models occurs, and what the current level of implementation is. In this way, it is possible to create a unified theoretical basis and encourage new research into circular business models including sustaining and disruptive innovation. Along with this, this study addresses the recommendation of Christensen et al. (2018)

encouraging academic attention on this subject and new research in the field of sustaining and disruptive innovations. Riesmeier (2020) added that sustaining and disruptive innovations have triggered important changes for companies in the last two decades.

Considering the context described, the research question that motivates this study is: what is the maturity level of Brazilian and Portuguese craft brewing companies regarding the circular economy and the ReSOLVE framework, in terms of technical and biological cycles and considering sustaining and disruptive innovation? In order to seek out evidence regarding this topic, a multiple case study was carried out with Brazilian and Portuguese craft brewing companies. This research accordingly explores the maturity levels of the circular economy via the ReSOLVE framework, looking at the technical and biological cycles and sustaining and disruptive innovations, which was enabled thanks to findings arising from in loco interviews carried out with companies located in the state of Santa Catarina (Brazil) and the city of Porto (Portugal).

The beer industry is directly connected with the progress and development of national economies. Understanding how craft breweries create, deliver, and capture value through the principles and practices of the circular economy with sustaining and disruptive innovations is relevant for the entire sector and the supply chains involved in the brewing business, as this will make it possible to highlight the current status of craft breweries' business models. The cold beverage industry in Brazil, of which the brewing sector forms a part, is the world's third-largest producer of beers. It is positioned behind only China and the United States and currently supplies more than 1.2 million points of sale throughout the national territory. In these establishments, the sale of beer and soft drinks represents between 40% and 60% of revenue. Faced with the challenge of transporting products over long distances, the sector has a renewal rate of 4000 to 5000 vehicles each year, with approximately 38,000 vehicles in its fleet. The country contains around 100,000 ha planted with cereals intended for the production of beer and is constantly seeking to diversify its portfolio with new flavors and packaging. The sector has reached the mark of 14.1 billion liters of beer produced per year and provides employment for around 2000 families involved in the production of the cereal (Brazilian Association of the Beer Industry, 2020).

In the Portuguese context, the craft beer industry generates in the order of 130,000 jobs through direct employment and another 255,000 jobs indirectly via the supply sector, including agriculture, packaging, and service industries. The sector delivers one million euros in taxes and promotes the growth of bars and restaurants, entertainment, and hospitality. Analysis shows that the craft beer sector is a potential source of employment for a wide range of workers, not only those with brewing-related skills but also all the specialist services that support the functioning of the business (Associação de Cervejeiros de Portugal, 2020 and Associação Brasileira de Cerveja Artesanal, 2020). The brewery sector promotes hospitality and is an important source of jobs for young people, often providing a way for these young workers to get their first job. There are several sectors that supply the beer industry, and this includes those that work to

supply the sector with bottles and containers, as well as those that work in a number of other sectors where beer is a part of the workload, justifying current levels of employment (for example, those who provide transport services). The largest sector from which breweries purchase supplies is the packaging sector, which includes both primary packaging, such as bottles and cans, and secondary packaging, such as plastic and cardboard packaging for these bottles and cans. Of the sector's total purchases, around 80% are domestic, thus stimulating the Portuguese industrial economy (Europe Economics, 2020).

The central theoretical contribution of innovative business models guided by the principles and practices of the circular economy concerns the model's value proposition and how it is generated in the organizational context (Morioka et al., 2018; Nußholz, 2018). However, the existing literature addressing this research problem is fragmented, with propositions that can support decision-making for the adoption of circular business models (Manninen et al., 2018).

Furthermore, it is still not clear which or what types of principles and practices predominate in these business models, that is, how they create, deliver, and capture value and under what organizational and contingency conditions of innovation this occurs (Brown et al., 2020). How the determinants and mechanisms of sustaining and disruptive innovation in circular business models behave in a specific sector and whose value creation bases involve originality, intangibility, and creativity, such as the craft brewery sector, are aspects that have so far been unsatisfactorily addressed, and this study seeks to analyze and answer how companies create, deliver, and capture value and whether these factors generate value in the organizational context.

1.1 | Circular economy, the ReSOLVE framework, and technical and biological cycles

The circular economy follows a principle of rational use of resources, and for its adoption by business models, natural resources (i.e., raw materials) must therefore be used in a way that enables manufacturing processes to reduce the generation of waste and to reintroduce the waste that is produced into processes for use in new components (Lacy et al., 2020). To ensure the necessary conditions for generating the benefits of the circular economy for businesses, cycles must be created with practices that favor technical and biological cycles and guarantee the conditions to leverage circular practices, create a commitment to sustainability, and incorporate actions from the ReSOLVE framework (Chen et al., 2019).

Business models can develop processes guided by the ReSOLVE framework and consider raw material extraction, conversion, manufacturing, distribution, use, and end-of-life management, to reuse, recover, and reintegrate the components of technical and biological cycles in new products (Bocken & Short, 2020). The Ellen MacArthur Foundation (2015) pointed to the circular economy principles of preserving and enhancing natural capital by controlling finite stock, balancing the flows of renewable resources, and optimizing resource yields by circulating products, components, and materials at the highest possible level. Thus, prolonging products' life cycles and

TABLE 1 Maturity levels of the circular economy and technical and biological cycles

Level	Circular economy	Technical and biological cycles
Nonexistent (0)	Practices are not implemented or do not achieve their goals.	No practices identified
Executed (1)	Practices are implemented and they achieve their purposes.	Collect, maintain/cascade, share, reuse/redistribute, and remanufacture/renew from technical and biological materials
Managed (2)	Practices implemented and processes executed; products are established, controlled, and monitored.	Displays indicators related to the dimensions: collect, retain/extend, share, reuse/redistribute, and remanufacture/renew
Established (3)	Practices managed and in compliance with standards or best practices	A history of indicators (2 years or more) related to the dimensions is presented: collect, maintain/extend, share, reuse/redistribute, and remanufacture/renovation
Predictable (4)	Established practices with measured and controlled results	In addition to presenting a history of indicators, the company presents continuous improvement goals for each indicator.
Optimized (5)	Predictable and critically analyzed and continuously improved processes	In addition to presenting a history of indicators, the company presents continuous improvement goals for each indicator, and when it does not reach it, a new goal is established for the next year.

Source: Adapted from Grant and Pennypacker (2006); Ellen MacArthur Foundation (2015); Sehnem et al. (2019a, 2019b); Salo et al. (2020); and Kerdlap et al. (2020).

implementing changes in production favor the reintroduction of components from technical and biological cycles in new applications (Breier et al., 2021).

The circular economy maturity levels are composed of evolutionary stages (Table 1), where the last stage is the maximization of process performance (Barra & Ladeira, 2018). Process maturation occurs according to these stages of evolution, from a non-existent initial stage (0) to an optimized final stage (5), through the incorporation of best practices, execution of continuous improvement, and constant evaluation and setting of goals for these processes (Salo et al., 2020).

Companies can be classified into levels, i.e., consecutive stages of maturity, which reflect the extent to which practices have been integrated into the company's activities (Salo et al., 2020). After surpassing the non-existent level (0), an improvement process begins with basic information about the processes and opportunities to act proactively occur in order to move toward the optimized level (5), in which stimuli are generated for the dissemination of knowledge, critical analysis, and promotion of best practices (Kerdlap et al., 2020).

1.2 | Sustaining and disruptive innovation

To innovate means to adopt differentiated products, services, or management strategies with the intention of increasing the company's competitiveness and expanding market share with the continuous introduction of changes in products, processes, and management (Riesmeier, 2020). According to Christensen (1997), sustaining innovations maintain the company's current business activities, while disruptive innovations create new dimensions in products, services, or management that were previously not available within the business model (Lacy et al., 2020).

As a strategy for stimulating companies to initiate innovation processes, it is recommended that they master the relevant concepts, listen to the needs of their customers, and be aware of market trends (Riesmeier, 2020). In addition to considering customer needs to generate innovations and offering a new mix of attributes to attract these customers, focusing on market trends and leaving the business's comfort zone are necessary. In this way, sustaining innovations can boost the company's permanence in the market, while disruptive innovations can trigger a new way to enter the market (Lacy et al., 2020).

Each maturity level (Table 2) has a set of criteria that indicates where innovation actors focus their improvement efforts (McCormack et al., 2008). Each level is described in terms of practices that contribute to meeting objectives (El Bassiti & Ajhoun, 2016). These practices describe the infrastructure and activities that contribute to the effective implementation and institutionalization of a specific maturity level (Salo et al., 2020).

Therefore, innovation maturity refers to the performance improvement that innovation actors aspire to achieve and results in better outcomes with minimized variations between performance goals and actual results as well as greater predictability of goals, costs, performance, and effectiveness in achieving objectives and the ability to improve and set new and ambitious goals (Salo et al., 2020). The components of this model complement each other and allow efforts to be directed toward constant and flexible performance (Xavier et al., 2020).

1.3 | The ReSOLVE framework, biological and technical cycles, and innovation

This study is theoretically supported by the circular economy research field and the circular design of products and processes, with circular

TABLE 2 Innovation maturity levels

Level	Practices
Awareness (1)	The management of innovation practices is unstructured and ill-defined. Process measures are not implemented, process performance is unpredictable, and objectives, if defined, are often overlooked. The costs of innovation maturity are high in functional, financial, and managerial terms.
Defined (2)	The basic innovation maturity processes are defined, but they remain obscure, elementary, and very simple. Process performance is more predictable, and goals are set, but frequency is still lacking. Innovation maturity costs remain high, frustration is still present, and satisfaction, although better defined, is still low.
Linked (3)	At this level, innovation maturity is implemented in processes with strategic intent and objectives. Process performance becomes more predictable, and objectives are often met. Continuous improvement efforts take shape and emphasize the elimination of root cause problems and improvements in performance. Costs start to go down, and feelings of teamwork take the place of frustration. Innovation actors are included in process improvement efforts, and their satisfaction starts to show marked improvements.
Managed (4)	Innovation actors achieve a perspective of wholeness based on wise and purposeful judgment. Innovation maturity management measures and systems are deeply embedded in the organization. Advanced innovation maturity practices such as creative imagination, collective engagement, and collaboration take shape. Process performance becomes predictable, and targets are reliably achieved. Process improvement goals are collectively defined and achieved with confidence. Innovation maturity costs are drastically reduced, and satisfaction and community spirit become a competitive advantage.
Sustained (5)	Advanced innovation maturity practices that allow self-responsibility are in place. Innovation processes involving goals and broad authority take shape. Trust, mutual dependence, and community spirit are characteristics that support the different actors. A creative and collaborative culture is firmly entrenched. Process performance and system reliability are measured and sustained with joint investments, and system improvement is shared, as are the returns. This is the beginning of a successful journey of networking innovation.

Source: Adapted from McCormack et al. (2008) and Salo et al. (2020).

flows considered as elements and aspects that activate circular inputs (Weetman, 2019). For this study, the definition adopted by the Ellen MacArthur Foundation (2012, 2015, 2017, 2019) has been adopted as a basic concept, which conceptualizes a circular economy as being an industrial economy that is restorative or regenerative in its intention and design, promoting improvements in technical and economic cycles and seeking to redefine the notion of growth, focusing on benefits for the whole of society (Singh & Ordóñez, 2016; Tukker, 2015). It adopts a circular business model construct that consists of regulated models that encourage restoration and regeneration processes (Prendeville & Bocken, 2017; Ünal & Shao, 2018) through interconnected activities that determine business relations between customers, partners, and suppliers in the creation, delivery, and capture of value (Favi et al., 2019), reshaping industry and society and helping to address the causes of unsustainability (Bocken & Short, 2020).

Figure 1 shows the connections between the aspects considered in this study.

For this study, the ReSOLVE framework proposed by the Ellen MacArthur Foundation (2015) is adopted, which addresses multisectoral practices that reinforce and accelerate the performance of companies through the use of physical assets, prolonging the useful life of materials and transitioning from the use of non-renewable resources to renewable ones. The ReSOLVE framework acts as a tool to generate circular strategies and sustainable growth initiatives (Heyes et al., 2018; Lewandowski, 2016; Merli et al., 2018; Parida et al., 2019).

In terms of theoretical support for innovation, the concepts of sustaining and disruptive innovation (Christensen, 1997) are used, a model in which sustaining innovation generates improvements in products or services to reaffirm the company's leadership, while disruptive innovation transforms an existing market or sector through the introduction of simplicity, convenience, and affordability in a way that can completely redefine the industry's direction (Lacy et al., 2020).

There are numerous circular economy business models cited in the literature, such as circular economy consulting companies (Kirchherr et al., 2017); companies with innovative business models (Michellini et al., 2017); drinking water companies and bespoke water services (Bocken, Schuit, et al., 2018); food, beverage, and furniture companies and industries (Gupta et al., 2018); water supply companies dealing with the use or supply of materials and payment periods (Pieroni et al., 2019); and companies in the chemical, oil, gas, textile, toys, packaging, food, and beverage industries (Lacy et al., 2020; Mokhtar et al., 2019). For this study, we adopted the specific context of the craft beer industry, which is part of the beverage industry business model.

All business models that follow the traditional linear economy can adopt sustaining or disruptive innovations to assist in the transition to a circular model (Christensen et al., 2016). Circular economy principles and practices based on the ReSOLVE framework drivers (Ellen MacArthur Foundation, 2015) can help in the transformation to circular business models (Figure 1) and allow for improvements in the models' technical and biological cycles (Morioka et al., 2018),

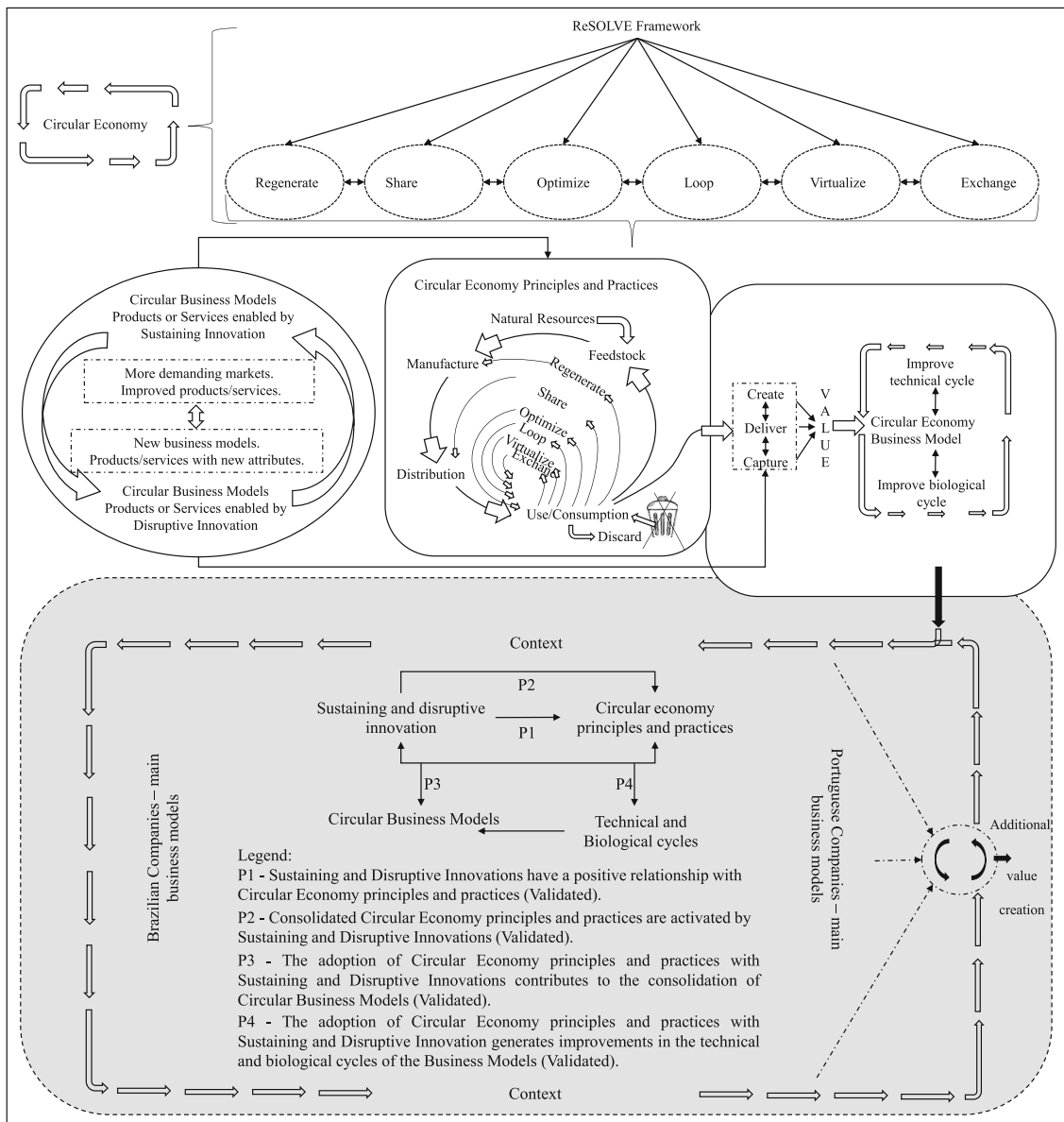


FIGURE 1 Research final framework

obtaining sustainable results by creating additional value for the business (Parida et al., 2019; Fernandes et al., 2020).

As solutions to achieve additional value creation, one can adopt the circular economy (Ellen MacArthur Foundation, 2015), which assumes that industrial systems must be restorative and regenerative in their principles and practices (Figure 1), incorporating the idea that products do not simply have an end of life and consequent disposal of materials but that they can be restored and regenerated for new applications without the need to discard them (Bocken & Short, 2020). In terms of factors that promote new forms and applications of materials, the ReSOLVE framework can be adopted as a driver of practices for new business models (Pieroni et al., 2019) in order to achieve additional value creation (Fernandes et al., 2020).

Sustaining and disruptive innovations (Figure 1) are possibilities for choosing a new path and can constitute an effective methodology

for companies to improve customer experiences and positioning, stimulate economic growth, and achieve market differentiation with sustainable competitive advantages (Christensen, 1997; Lacy et al., 2020). According to Christensen (1997), innovation happens when a product or service undergoes updates or becomes something new (Christensen et al., 2016) and contributes to creating, delivering, and capturing value in companies that adopt the principles and practices of the circular economy in their business model (Lacy et al., 2020; Mokhtar et al., 2019). Based on the premises of sustaining and disruptive innovation, we present research Proposition 1: Sustaining and disruptive innovations have a positive relationship with circular economy principles and practices.

Business models are viewed from a value creation perspective (Baldassarre et al., 2020) that aims to satisfy consumer needs, generate economic returns, and create new opportunities (Korhonen et al.,

2018; Stubbs & Cocklin, 2008). To deliver value, companies provide their stakeholders with products or services through key resources such as activities, partnerships, satisfaction, and functionalities (Bocken & Short, 2020; Malik et al., 2019). To capture these values, they consider measures of profit, reputation, brand growth, and cost reduction (Centre for Industrial Sustainability, 2016; Parida et al., 2019).

In this way, circular economy principles and practices preserve and enhance natural capital and control finite inventories to balance flows, maximize returns, and circulate products, components, and materials at the highest level of utility at all times, both in the technical and biological cycles (Bocken & Short, 2020; Bocken et al., 2020). The circular economy generates stimuli for the effectiveness of the system and, from the beginning, reduces the negative externalities of the business (Ellen MacArthur Foundation, 2015). Along with the practices of the ReSOLVE framework (Merli et al., 2018), changes in products and processes can be developed by introducing innovations to eliminate waste and pollution, keep products and materials in use cycles while avoiding disposal, and help to regenerate waste materials through technical and biological cycles (Domenech et al., 2019; Fernandes et al., 2020). These arguments provide the basis for Proposition 2: Consolidated circular economy principles and practices are activated by sustaining and disruptive innovations.

The adoption of circular economy principles and practices (Ellen MacArthur Foundation, 2015) with sustaining and disruptive innovations requires the company to invest in its own business model and innovation to protect itself from the adverse effects of market disruption (Riesmeier, 2020), with constant investments in research and development of new products and processes (Chen et al., 2019). In this way, it allows the company's strategies to generate support for a circular economy transition supported by innovations in business models (Riesmeier, 2020; Sarasini & Linder, 2018).

The adoption of circular economy principles and practices (Ellen MacArthur Foundation, 2015) with sustaining and disruptive innovations will develop three forms of core value propositions in terms of creation, delivery, and capture (Pieroni et al., 2019). An economy that promises a new business model (Brown et al., 2020) that can decouple economic growth and environmental pressure from use, consumption, and disposal and encourage regenerative and restorative methods through the intention and design of industrial systems (Singh & Giacosa, 2018) will promote the value proposition of prolonging the life of products and contributing to encouraging reuse and regeneration (Parida et al., 2019; Malik et al., 2019; Lacy et al., 2020). These arguments provide the basis for Proposition 3: The adoption of circular economy principles and practices with sustaining and disruptive innovations contributes to the consolidation of circular business models.

The adoption of circular economy principles and practices (Ellen MacArthur Foundation, 2015) with sustaining and disruptive innovations allows companies to preserve and increase capital (Bocken et al., 2020), optimize and improve the efficiency of production and processes, and keep resources within the economy so that

they can be reused and continue to generate value (Di Maio et al., 2017). The circular economy promotes flows of resources through multiple cycles in different sectors, activities, and chains, being restorative and regenerative in intention and design (Fernandes et al., 2020) to allow resources to be kept at the highest possible utility and value in technical and biological cycles (Domenech et al., 2019).

Within technical and biological cycles, materials are created and used in order to differentiate between the technosphere and the biosphere (Bressanelli et al., 2017). Materials optimized for the technical cycle are considered technical nutrients and utilized so that they circulate in closed industrial cycles, especially those that are not continuously produced by the biosphere, that is, non-renewable materials (Lacy et al., 2020). Materials optimized for the biological cycle will be biodegradable or obtained from plant matter and return their value as biological nutrients for human, animal, or soil applications (Heyes et al., 2018). Thus, applications in technical and biological cycles help to deal with sustainability issues and aim to promote innovation in cycles to shift the economic logic of disposal toward the economic logic of industrial systems that use restorative and regenerative practices (Bocken et al., 2020; Pieroni et al., 2018). These arguments provide the basis for Proposition 4: The adoption of circular economy principles and practices with sustaining and disruptive innovations generates improvements in the technical and biological cycles of business models.

The adoption of the circular economy with sustaining and disruptive innovations can lead to reduced costs, reduced risks, reduced waste, improved relationships, and increased revenues (Abreu & Ceglia, 2018; Di Maio et al., 2017). To generate these outcomes, innovation in the business model is fundamental, so that the set of available elements can allow the company's architecture to create, deliver, and capture value (Nußholz et al., 2019). In the traditional business model context, value is calculated based on economic results for the company and customers (Massa & Tucci, 2014). In the domain of circular economy business models, value is understood more broadly and considers a wide range of stakeholders such as value chain partners, the environment, and society (Nußholz et al., 2019). All of these factors need to be integrated into the company's processes (Brown et al., 2020) in order to foster internal circular economy loops and thereby add value in all processes, covering both technical and biological cycles (Brown et al., 2020; Mokhtar et al., 2019).

1.4 | Methodological procedures

This research was carried out in the state of Santa Catarina (Brazil) in September, October, and November 2020 and in the city of Porto (Portugal) in April, May, and June 2021. To categorize Brazilian (Table 3) and Portuguese (Table 4) craft brewing companies, the code BCB (Brazilian Craft Brewery) is used for Brazilian companies and PCB (Portuguese Craft Brewery) for Portuguese companies, along with a specific number that corresponds to the sequence in which the visits occurred.

TABLE 3 Brazilian craft beer companies

Position	Educational level	Gender	Company code	Time at company (year)	Monthly production (L)	Coverage
Owner	Post-graduate	M	BCB01	3	8000	Local
Owner	Post-graduate	M	BCB02	8	12,000	State
Owner	Post-graduate	M	BCB03	8	12,000	Local
Master brewer	Post-graduate	M	BCB04	2	6000	Local
Master brewer	Post-graduate	M	BCB05	5	10,000	State
Owner	Post-graduate	F	BCB06	3	140,000	South Region
Owner	Post-graduate	M	BCB07	5	500,000	National
Owner	Post-graduate	M	BCB08	4	140,000	State
Owner	Post-graduate	M	BCB09	7	140,000	South Region
Master brewer	Post-graduate	M	BCB10	10	500,000	National
Master brewer	Post-graduate	M	BCB11	5	120,000	South Region

TABLE 4 Portuguese craft beer companies

Position	Educational level	Gender	Company code	Time at company (year)	Monthly production (L)	Coverage
Owner	Post-graduate	M	PCB01	5	2000	Local
Owner	Post-graduate	M	PCB02	5	3000	State
Owner	Post-graduate	M	PCB03	10	120,000	National
Owner	Post-graduate	F	PCB04	4	500	Local
Owner	Post-graduate	M	PCB05	4	3500	State
Owner	Post-graduate	M	PCB06	4	6000	North Region
Owner	Post-graduate	M	PCB07	7	3000	Local
Owner	Post-graduate	M	PCB08	5	5000	North Region
Owner	Post-graduate	M	PCB09	6	100,000	National
Owner	Post-graduate	M	PCB10	4	4000	State
Owner	Post-graduate	M	PCB11	3	1500	Local

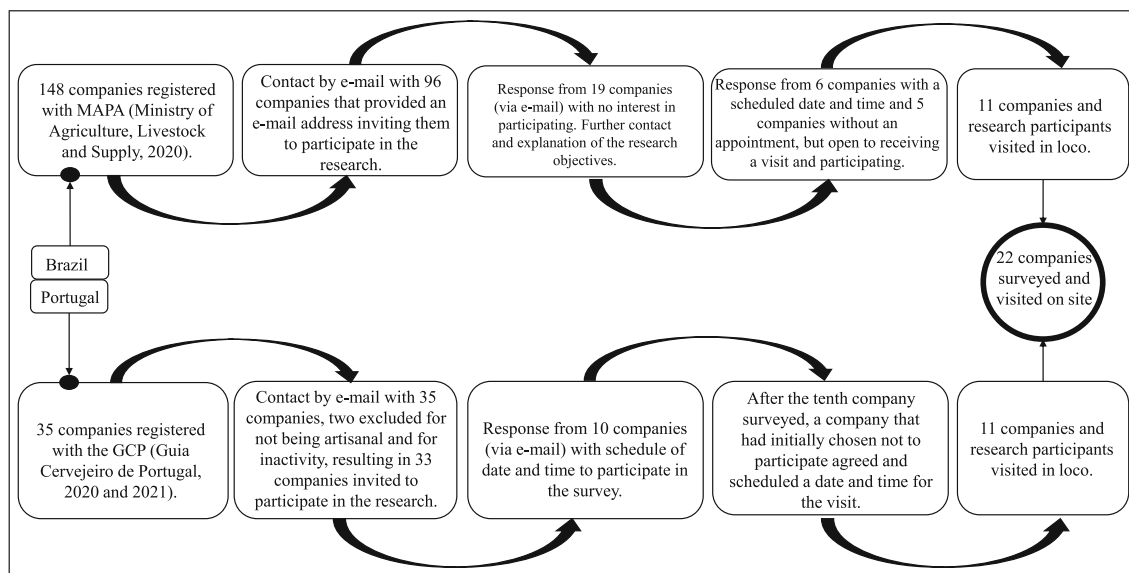


FIGURE 2 Research design

As a data collection tool, 22 semi-structured interviews were conducted with 18 owners and four master brewers indicated by the brewery owners. An interview script was prepared, covering 13 questions related to the circular economy and innovation. After the interview, respondents were asked to rank their company according to its maturity level; thus, 30 questions related to the circular economy were addressed using the ReSOLVE framework, 12 questions related to technical and biological cycles, and 29 questions related to innovation practices.

The interviews were carried out at the headquarters of the Brazilian and Portuguese companies and recorded with the authorization of the owners. This resulted in more than 10 hours of recordings, indicating an approximate average of 45 minutes per company. At the invitation of the 22 interviewees, it was possible to carry out technical visits to their sites to experience the production processes discussed. The number of companies involved was not predetermined, and their recruitment occurred differently in the Brazilian and Portuguese contexts (Figure 2).

After collecting the data, all the interviews were transcribed. Data coding was performed manually along with a priori definition of the analysis dimensions of the study, namely, a) the ReSOLVE framework (regenerate, share, optimize, cycle, virtualize, and exchange) and b) the maturity levels (non-existent, executed, managed, established, predictable, and optimized). For each level evaluated, practices were chosen in light of the existing literature for identification in the locus of analysis. The number of circular economy and innovation practices found in the interviews was counted. These data were combined with data sourced from documents, technical reports, flyers, website data, and online interviews found via web searches. If there was mention in at least two sources of the existence of a certain practice, it was considered valid to be cited as present in the relevant company.

Our data analysis followed the tabulation criteria recommended by Sehnem et al. (2019a, 2019b), namely, the unit of analysis of this research is the determinants of the circularity of resource usage in organizations. Value creation resides in the ability to preserve embedded labor, energy, material, and capital costs in superior forms of product and component integrity. This can be achieved in four ways: a) The implementation of the business models involves extending the use of the product (and reducing currently planned obsolescence); b) reuse or redistribution involves an existing product, which is resold to a new user with little or no rework (i.e., secondary use of the same product for a secondary user or purpose); c) refurbishment and remanufacturing involve the use of components to create new uses for existing products; and d) recycling involves resources that are extracted into more basic and interchangeable forms (e.g., grinding and re-melting metals into new metal feedstock). Therefore, the determinants of resource circularity are the technical cycles and biological cycles of the circular economy (Ellen MacArthur Foundation, 2013).

As for the maturity levels of business models, the recommended typology was followed, adapted from Grant and Pennypacker (2006) and also adopted by Sehnem et al. (2019a, 2019b). This scale defines the maturity levels of business models thus:

Level Zero (0) Non-existent: Practices are not implemented or do not achieve their purpose.

Level One (1) Implemented: Practices are in place and achieve their purpose.

Level Two (2) Managed: Practices are implemented, processes are performed, and products are established and controlled and are still managed, monitored, and appropriate.

Level Three (3) Established: Managed practices adhere to standards, norms, or best practices.

Level Four (4) Predictable: Practices are established and their results are measured and controlled.

Level Five (5) Optimized: Processes are predictable and critically analyzed and continually improved.

The data were interpreted through cross-analysis and triangulation, which enabled the elaboration of qualitative information through figures, summary tables, and consecutive paragraphs discussing the facts observed during the visits and interviews (Yin, 2015). Thus, we proceeded to explore the corpus by exhaustively reading each of the 22 interviews, supported by the recordings, the theoretical framework, and notes made during the interviews. These steps allowed for a careful and reflective analysis to establish the interfaces between the circular economy maturity levels through the ReSOLVE framework and the maturity levels of sustaining and disruptive innovations.

The categories of analysis were defined before data collection through a systematic literature review using the search terms “Circular Business Model” OR “Circular Economy Business Model” OR “Sustainable Business Model” AND “Circular Economy” and “Disruptive Innovation Theory” AND “Disruptive Innovation” AND “Sustaining Innovation” in the Scopus, Web of Science, Ebsco, Proquest, Science Direct, Spell, Emerald, Sage, and Wiley Online Library databases. The results led us to the categories of analysis and enabled the integration of the constructs in a theoretical way along with empirical observations to support our analysis.

2 | RESULTS AND DISCUSSIONS

Interpretation of our results enabled us to explore the maturity levels of 11 Brazilian and 11 Portuguese companies, as well as to categorize them according to three analytical categories: the maturity level of the circular economy through the ReSOLVE framework, the maturity level of the technical and biological cycles, and the level of maturity of sustaining and disruptive innovation.

2.1 | Circular economy maturity level through the ReSOLVE framework

The circular economy maturity levels of the Brazilian and Portuguese companies studied, identified through the ReSOLVE framework, show that the optimized level (5) presented the highest rate of actions performed (Figure 2). Aware that the circular economy and the

ReSOLVE framework are two interconnected aspects that allow for a business model to become circular, companies become more conscious and are structured (or in the process of becoming more structured) to guide practices toward optimization.

Figure 3 presents the circular economy maturity level of the analyzed cases. A scale ranging from 0 to 5 was adopted to classify the stage of maturity of these practices, with zero denoting non-existent and 5 denoting optimized. The variations between levels 1 and 4 represent the stages of development of these practices. To evaluate the circular economy, the ReSOLVE framework was adopted for each case. In the analysis dimension, relevant practices were listed in the light of the prior relevant literature. A numerical count of the frequency of each of the practices was made, and the status of development of these practices was analyzed in each case.

Brazilian and Portuguese companies are at different stages concerning their circular economy maturity levels, according to the ReSOLVE framework (Figure 3). The results indicate that, although the optimized level (5) is mostly achieved by Portuguese companies, with 249 actions, both Portuguese and Brazilian companies demonstrate practices at different levels.

Figure 4 presents a summary of the results obtained regarding the circular economy maturity level of the analyzed cases. For each of the circular economy dimensions, the maturity levels were analyzed. The numbers represent the number of practices that were mentioned/found in the analyzed cases.

The difficulties mentioned by the companies in developing all their practices to the optimized level (5) relate to planning, investments, and practical management actions in production processes. In

Aggregate of the 11 Brazilian companies surveyed organized by circular economy maturity level using the ReSOLVE Framework																															
Level \ Practice	a. Regenerate				b. Share				c. Optimize				d. Loop				e. Virtualize				f. Exchange				Total per level						
	a1	a2	a3	a4	a5	b1	b2	b3	b4	b5	c1	c2	c3	c4	c5	d1	d2	d3	d4	d5	d6	e1	e2	e3	e4	e5	f1	f2	f3	f4	
0 Non-existent	11				35								20				16				4				86						
1 Executed	1				2				7				6				4				7				27						
2 Managed	13								3				1								8				25						
3 Established	1												4				2								7						
4 Predictable									5				16				7				3				31						
5 Optimized	29				18				40				19				26				22				154						
Total	55				55				55				66				55				44				330						

Aggregate of the 11 Portuguese companies surveyed organized by circular economy maturity level using the ReSOLVE Framework																															
Level \ Practice	a. Regenerate				b. Share				c. Optimize				d. Loop				e. Virtualize				f. Exchange				Total per level						
	a1	a2	a3	a4	a5	b1	b2	b3	b4	b5	c1	c2	c3	c4	c5	d1	d2	d3	d4	d5	d6	e1	e2	e3	e4	e5	f1	f2	f3	f4	
0 Non-existent	5				12												2				12				31						
1 Executed	3																4				2				9						
2 Managed					4				1								3				1				9						
3 Established	2				6				2				2				3				2				17						
4 Predictable	1				3				1				4				3				3				15						
5 Optimized	44				30				51				60				40				24				249						
Total	55				55				55				66				55				44				330						

FIGURE 3 Circular economy maturity level of Brazilian and Portuguese companies in the ReSOLVE framework

Aggregate of the 11 Brazilian companies based on maturity level of technical and biological cycles								
Technical Cycle	Recycling	Discard	0 Non-existent	1 Executed	2 Managed	3 Established	4 Predictable	5 Optimized
h1. Sacks (malt packaging)	8	3	2				1	8
h2. Glasses	8	3	2				1	8
h3. Lids	6	5	4				1	6
h4. Cardboard	10	1					1	10
h5. Miscellaneous packaging	10	1					3	8
Total	42	13	8	0	0	0	7	40

Aggregate of the 11 Portuguese companies based on maturity level of technical and biological cycles								
Biological Cycle	Recycling	Discard	0 Non-existent	1 Executed	2 Managed	3 Established	4 Predictable	5 Optimized
i1. Malt husk	11	0						11
i2. Malt cake	11	0						11
i3. Starch (Grinding Powder)	10	1	1				1	9
i4. Hop scraps	10	1	1				1	9
i5. <i>Trub</i>	9	2				2	1	8
i6. Boiling (Yeasts)	11	0					1	10
i7. Water	11	0					1	10
Total	73	4	2	0	0	2	5	68

Aggregate of the 11 Portuguese companies based on maturity level of technical and biological cycles								
Technical Cycle	Recycling	Discard	0 Non-existent	1 Executed	2 Managed	3 Established	4 Predictable	5 Optimized
h1. Sacks (malt packaging)	11	0						11
h2. Glasses	11	0						11
h3. Lids	11	0						11
h4. Cardboard	11	0						11
h5. Miscellaneous packaging	11	0						11
Total	55	0	0	0	0	0	0	55

Aggregate of the 11 Portuguese companies based on maturity level of technical and biological cycles								
Biological Cycle	Recycling	Discard	0 Non-existent	1 Executed	2 Managed	3 Established	4 Predictable	5 Optimized
i1. Malt husk	11	0						11
i2. Malt cake	11	0						11
i3. Starch (Grinding Powder)	11	0						11
i4. Hop scraps	11	0						11
i5. <i>Trub</i>	11	0						11
i6. Boiling (Yeasts)	11	0						11
i7. Water	11	0						11
Total	77	0	0	0	0	0	0	77

FIGURE 4 Aggregate of the 11 Brazilian companies based on maturity level of technical and biological cycles

addition to these difficulties, different practices trigger specific factors in each company, thus bringing specific challenges for optimization in the management of and investments in the brewing business model. To support these assertions, we provide excerpts of the interviews carried out with the companies.

We found difficulties in the operationalization of practices due to the company's expansion and implementation of new machines, equipment and reorganization of the gastronomic space, but perhaps one day there will be changes toward the business and we will be able to optimize all practices. (BCB06 and PCB04)

It should be noted that our behavior is anchored in sustainability and incorporated into the company's

business model. But we are aware that the actions not taken reflect problems in the company's use of best practices and promoting the sustainability of these practices. (BCB11 and PCB06)

It appears that the maturity level of the circular economy according to the ReSOLVE framework differs in both Brazilian and Portuguese companies. The results do not allow the companies to be jointly positioned at a specific level of maturity, and it appears that there is no complete optimization of practices in any of the 22 companies surveyed. Although the Portuguese companies present better results in terms of optimized practices (5), this does not ensure that a complete optimized level of practices will eventually occur in the Brazilian companies, since the management actions for prioritizing each practice are different across business models.

2.2 | Maturity level of technical and biological cycles

The maturity levels of Brazilian and Portuguese companies in the technical and biological cycles are presented through formalized and executed practices, with sustainable management identified in recycling practices and continuous improvement in both cycles (Figure 4). Recycling, reuse, and reintroduction of waste products from other cycles are considered. The circularity of the resources involved in these cycles is linked to actions that relate to the controls performed in the processes, quality control in the acquisition of raw materials, and control of the final disposal of waste products.

Figure 5 presents the relevant practices, referring to the technical and biological levels that were mapped in the cases studied. These practices were quantified according to the recycling and disposal dimensions. The numbers represent the number of times each practice was named. Likewise, regarding the maturity level, they were tabulated on a scale from 0 to 5, with zero being non-existent and 5 being an optimized level.

The activities of these companies, from the acquisition of raw materials, through production to delivery of the product to the final consumer, promote value for these cycles through technological improvement, quality control, and attention paid to processing time. These assumptions help companies in their recycling practices because they raise awareness of control at all stages and develop the perception that recycling the components of a cycle generates new opportunities with financial, social, and environmental returns (Parida et al., 2019).

Keeping products, components, and materials at a high level of utility and value is mentioned by the companies surveyed as delivering

the potential for resilience and business permanence in the market (Figure 6). They point out that the circular economy, as a driver for improvements in both cycles, promotes continuous improvement and prevents the company from becoming stagnant; that is, the company is constantly searching for new uses of waste products in order to remain optimized (5).

Portuguese companies are positioned at the optimized level (5), reflecting the integration of these practices in the companies' management and activities. In addition to presenting a history of indicators, they have goals for continuous improvement and invest in cycles to differentiate themselves from competitors and add value. The reality of the Brazilian companies is similar to the Portuguese context, as they also display optimization of practices, which are integrated into management and daily activities. A few reports from the interviewees confirm this assertion:

We present non-optimized practices in the technical and biological cycles and we are uncomfortable with this and highlight deadlines and objectives to optimize them by 2022, as we are proactively working toward continuous improvement and searching for new technologies to optimize results. (BCB01, BCB03, BCB04, and BCB07)

We believe that investments in healthy practices for the company and the environment are essential in technical and biological cycles and we emphasize the importance of complete optimization (5) of cycles because recycling, as a healthy practice, beneficial to the company and society, generates new revenue and

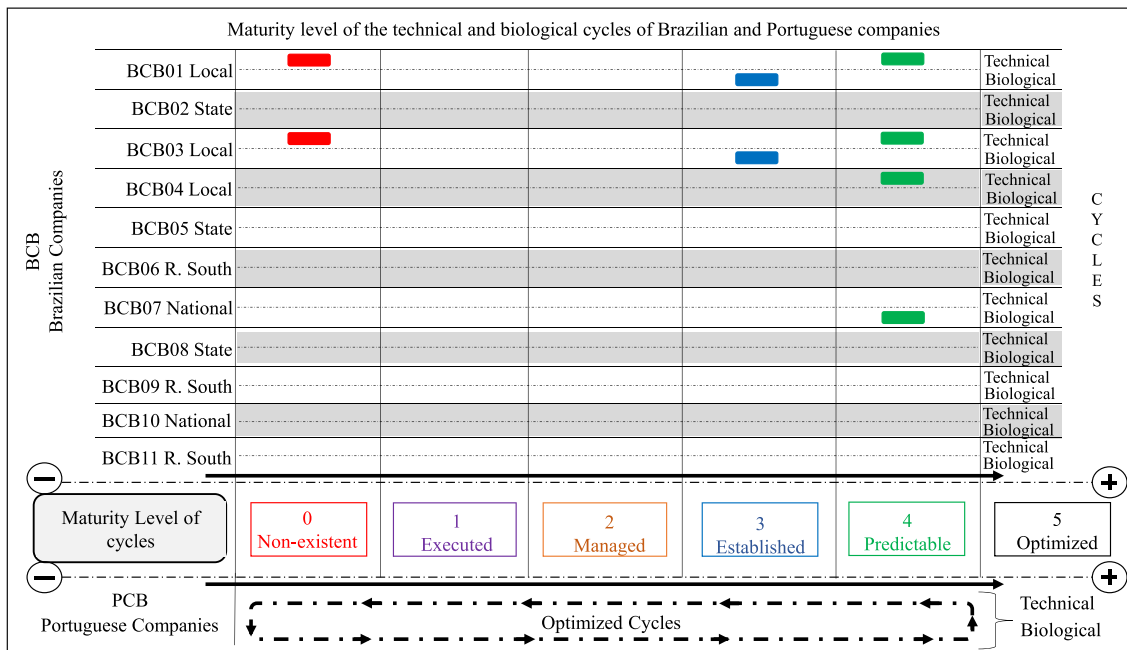


FIGURE 5 Maturity level of technical and biological cycles of Brazilian and Portuguese companies

Aggregate of the 11 Brazilian companies by innovation maturity level																															
Level	Practice	j1	j2	j3	j4	j5	j6	j7	j8	j9	j10	j11	j12	j13	j14	j15	j16	j17	j18	j19	j20	j21	j22	j23	j24	j25	j26	j27	j28	j29	Total
0	Non-existent				3							3					2	2				4	2						3	19	
1	Awareness							1			2				3															3	9
2	Defined								1		1		3							2			1							3	11
3	Linked		2				1	4					2			3						4		3		1				2	22
4	Managed	2		1		5	4		4	2	2		6	5	1	3	5	5	2	3	2		2	2	2	2					60
5	Sustained	9	9	10	8	6	6	6	6	9	6	8		6	7	5	4	4	9	6	9	3	6	6	9	8	11	11	11		198
Total		11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	319	

Aggregate of the 11 Portuguese companies by innovation maturity level																															
Level	Practice	j1	j2	j3	j4	j5	j6	j7	j8	j9	j10	j11	j12	j13	j14	j15	j16	j17	j18	j19	j20	j21	j22	j23	j24	j25	j26	j27	j28	j29	Total
0	Non-existent				2											1														3	6
1	Awareness				2									1		1														1	5
2	Defined																2													2	4
3	Linked			1	2				1					2				2		3					1	1		1		3	17
4	Managed				4				1					1		2		1		5					2	1		2		2	21
5	Sustained	11	11	10	1	11	11	11	9	11	11	11	11	7	11	7	9	8	11	3	11	11	11	11	8	9	11	8	11		266
Total		11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	319	

FIGURE 6 Aggregate of the 11 Brazilian companies by innovation maturity level

contributes to the continuous improvement of the business. (BCB02, BCB05, BCB06, BCB08, BCB09, BCB10, and BCB11)

Promoting cycle optimization allows for positioning the company in the market as a responsible institution with a sustainable business model. Reintroducing and reusing leftover components from technical cycles in new materials promotes continuous improvement and prevents waste from being generated in landfills. Waste products from biological cycles allow new applications in gastronomy such as breads or flours to integrate into recipes. Also, waste products from biological cycles allow the development of soaps, shampoos, conditioners, animal feed and fertilizer for agriculture. (PCB01, PCB02, PCB03, PCB04, PCB05, PCB06, PCB07, PCB08, PCB09, PCB10, and PCB11).

These results show that the stages of maturity in the technical and biological cycles of Brazilian companies are optimized (5) or close

to reaching optimization, and Portuguese companies also have optimized cycles (5). The practices of technical and biological cycles, aligned with the circular economy, improve companies' results, meet the planet's demands for sustainability, and emphasize the maintenance of corporate reputation (Lopes & Demajorovic, 2020).

2.3 | Maturity level of sustaining and disruptive innovation

Innovation maturity levels provide perspectives on the ability to show improvements in innovation, denote the ability to perform tasks and deliver results, and allow us to analyze the current levels to project future evolution (McCormack et al., 2008). According to the 22 companies surveyed, innovations promote continuous improvement, reinforce businesses' resilience, and promote ideas for continuous improvement (Figure 7).

Companies can adopt sustaining and disruptive innovations as promoters of product and service improvements and demonstrate their innovation capabilities to the market. In addition, these practices

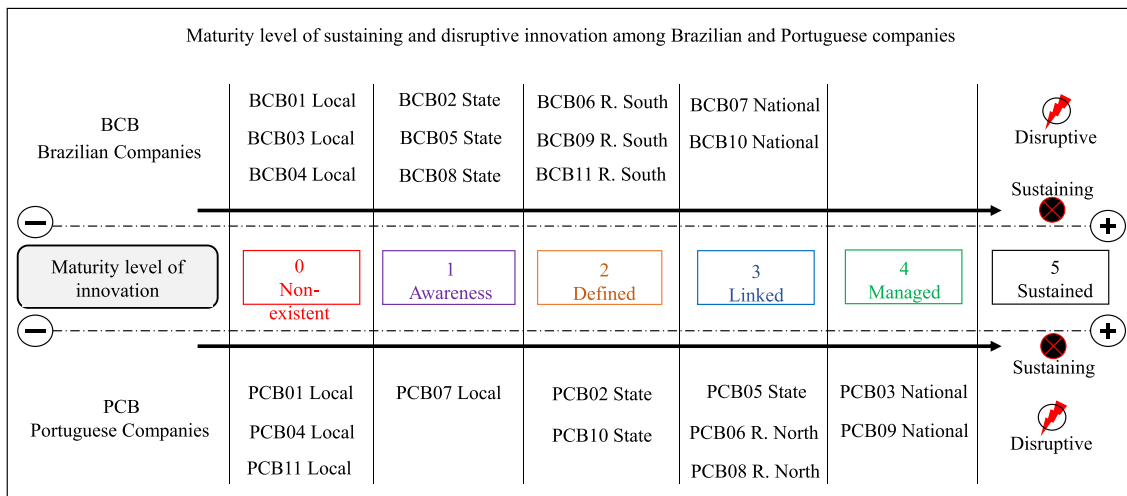


FIGURE 7 Maturity level of sustaining and disruptive innovation among Brazilian and Portuguese companies

show that they can be open to different business architectures and can enable linear products and services to become circular (Salo et al., 2020). The results in this segment do not allow us to group the companies at a specific level. Thus, the sustained level (5) of innovation practices was not observed in any of the 22 companies surveyed. Although Portuguese companies present better results in terms of the number of practices at higher levels, this does not imply that the sustained level (5) will occur in Brazilian companies, since management actions regarding the intention and priorities of each practice are different amongst the business models.

Riesmeier (2020) pointed out that sustaining and disruptive innovations have triggered important changes for companies in the last two decades. Brewery companies are unanimous in pointing out these changes, and they affirm that innovations promote improvements in the sector and provoke entrepreneurs, disrupting the industry and leading them to constantly analyze the market in order to develop innovations. Sustaining innovation is presented as a sustained practice (5) in the management of Brazilian and Portuguese companies and is referred to as essential for the maintenance of business, permanence in the market, and achievement of customer satisfaction (Figure 7). As factors of sustaining innovation, the continuous improvement of products and processes is pointed out through the introduction of Industry 4.0 technologies and the reintroduction of waste products from biological cycles in products for human and animal food and hygiene products.

In the four types of disruptive innovation—product and service innovation, process innovation, business innovation, and management innovation (Christensen, 1997)—a parallel is established that positions Brazilian and Portuguese companies at different levels of maturity in terms of innovation. The results do not allow for grouping the companies at a specific level; thus, the sustained level (5) was not identified in any of the 22 companies surveyed. The following reports strengthen this statement.

The company was born within green concepts and is recognized in the market for these concepts. It combines innovations to consolidate the circular economy and emphasize the company's strategy for sustainable innovation practices with integrative, restorative and regenerative processes. Innovations must be part of the company's day-to-day to consolidate sustainability. (BCB02, BCB03, PCB08, and PCB10)

Using circular economy practices combined with innovations to analyze the market and trace safe routes helps business and improves the company's results. Adopting sustainability through daily actions in the technical and biological cycles and thinking about sustainability with innovation is a matter of business model survival. (BCB06, BCB11, PCB02, and PCB06)

Innovations help to deal with sustainability issues and aim to promote innovation in cycles to shift the economic logic of disposal to the economic logic of restoration and regeneration and with that, cycles can be constantly improved with new technical and biological applications. (BCB05 and PCB07)

Although Portuguese companies present better results in terms of the number of practices at each level, this does not mean that the sustained level (5) will also occur in the Brazilian companies, since management actions for the intention and priorities regarding each practice differ between the business models. Moreover, Portuguese companies with a national scope are positioned one level above Brazilian companies with the same national scope. Additionally, each company has its own definition of business models and points out the

TABLE 5 Definition of business models and references to sustaining and disruptive innovations

Company	Definition of business model according to company	Reference to sustaining innovations practiced	Reference to disruptive innovations targeted (-) or in process (*)
BCB01 local	Business model with economic, social, and environmental objectives aligned with the client to generate and capture value.	Modern equipment to improve product quality.	- Who would not want to introduce something disruptive and become the best in this business.
BCB02 state	A business model that provides the customer with a diversity of flavors to meet all tastes through high-quality products.	Innovations in the production process regarding processing times.	- Attention to new technologies, and pursuit of partnerships for continuous improvement. Future project to build a training center to share experiences, in addition to developing continuous improvement and encouraging new businesses.
BCB03 local	A business model that is good for all customers and enables the establishment of a proposal that generates value for the entire chain.	New equipment that supports Industry 4.0 technologies to improve the quality of products.	- Remodel the company and invest in new equipment to improve and develop something innovative.
BCB04 local	Business model that is dedicated to customers and seeks to listen to the customer to try to make the product they want.	Equipment that precisely controls each step with product improvement.	- Investment in more modern equipment that helps to reduce the use of resources, improving controls and products to pursue something innovative.
BCB05 state	Business model that follows market logic to create, deliver and capture value to generate revenue and keep the company healthy.	New tanks that allow computer monitoring to improve quality and reduce the risk of non-conformities in the final product.	- State-of-the-art technology to develop innovative processes and products for the market.
BCB06 south region	Business model aligned with sustainability and innovation to generate better results for the company, environment, and society.	Machinery with an ozone system that kills contaminants, without having to use chemical products to wash the barrels; management software for Dash Board; QR code on menus.	* Qualification in foreign trade to export in Mercosur and research to introduce a new product on the market.
BCB07 national	Business model supported by constant investments in quality improvement and maintenance of industrial standards, supported by investors, to generate brand value and maintain and conquer new markets.	New filling line and new storage tanks to improve quality and increase production; process control and management software.	* Vegan draft beer without chemical additives at any stage to serve a large portion of the population that today does not consume the product because it does not meet certain requirements.
BCB08 state	Business model with a controlled and improved production method to generate revenue, keep the company healthy and satisfy customers.	Management software that allows access to all documentation and processes in real time to promote agile and accurate customer service.	- Technological package to transform the company and position it at a higher level with innovative products and processes.
BCB09 south region	Business model that provides leisure and rest for people and allows them to forget about their routine, relax, and feel happy.	Electronic manager that checks the fermentation of the mash and its state every 3 seconds; a form of control to check what happens in the process; centrifuge with German technology that separates protein and vitamin B complex; Technology 4.0 to control biological factors.	* Research on hop and malt varieties, which are in the process of being adapted for local production; research into own yeast strains and the use of aromatic compounds from hops (which are a source of bitterness and aroma) to remove aromas and essential oils before they are lost in the boiling processes, thus generating new products.
BCB10 national	Business model based on understanding markets and seeking new solutions to increase participation at the national level.	Reintegration and reuse with reverse logistics in technical cycles; structured quality area to carry out controls in the stages of must, fermentation, maturation times, filtration, and packaging; "kits" for gifts.	* Plan for new markets and new products with greater production volume and new flavor and packaging options; research to introduce product innovations in the fitness market and for the female audience.

(Continues)

TABLE 5 (Continued)

Company	Definition of business model according to company	Reference to sustaining innovations practiced	Reference to disruptive innovations targeted (-) or in process (*)
BCB11 south region	Business model that keeps the enterprise active for current customers and seeks improvements to increase production and conquer new markets.	Acquiring competitive products to analyze packaging, taste, smell, and product density; replacing obsolete equipment with new ones that allow technological integration.	- Find a competitive edge that customers want and position the company at a higher level.
PCB01 local	A business model anchored in the circular economy to compete with affordable prices and a product built according to the customer's olfactory and gustatory perceptions to compete with the big brands.	By-products used for making beer soaps, biscuits for human consumption, and fish feed; product that uses hemp flowers (Cannabidiol) together with organic barley and hops from organic farming.	* Management program that allows for monitoring in real time of the evolutionary stages of the beverage through a digital platform "To Go - To Back for Beer" and allows monitoring of brewing behavior (this name is fictitious and has been modified to preserve the identity of the brewing company's platform which is in the final stages of testing and patenting); program under implementation called "Store beer shop" (this name is fictitious and has been modified to preserve the identity of the brewing company's platform which is in the final stages of testing and patenting).
PCB02 state	Business model that thinks about sustainability with innovation to optimize activities and survive in the beer market.	Technological use to promote improvements in products and processes.	- Research new flavors, new aromas, and new product presentation strategies.
PCB03 national	Business model that produces beer responsibly and ethically, using technology and knowledge to generate sustainable products and create new business opportunities.	Use of 100% sustainable, recycled, and recyclable bio-based packaging; end-to-end technology deployment.	- Use of technology and knowledge to generate sustainable products and create new business opportunities.
PCB04 local	Business model that respects the environment because there is no planet B.	Products without the addition of chemical components.	- Access to technologies that are still bureaucratic and expensive for small businesses.
PCB05 state	Business model that loves flowers and beers.	Gastronomy awareness program "sustainable energy and beer, do your part too"; formulations and combinations of dandelion flower, citronella, and lemon peel.	* Disruptive innovation that will position the company by means of another product and exclusive patented formula; combination of flowers and herbs considered medicinal and combinations of flowers with red fruits, grapes, and chestnuts.
PCB06 north region	A business model that is aligned with the green principles of the circular economy, capable of investing and changing processes to answer the world's call for sustainable development.	Apple and lemon-flavored beers; software that manages processes with results in real time.	* Modeling a new portfolio that lists the best practices that the company develops.
PCB07 local	Business model that meets the planned economic, social, and sustainability objectives with efficient and conscientious management to meet and comply with laws.	Benchmarking in Portugal and in European countries and products according to the old brewing traditions.	- Innovations with sustainability in management and manufacturing to transform the market.
PCB08 north region	Business model that takes advantage of waste resources with the adoption of the circular economy to reuse them and turn them into new products or components.	Digitization of systems to improve the quality of products and processes.	- Using circular economy concepts to generate a new product that promotes sustainable concepts.

TABLE 5 (Continued)

Company	Definition of business model according to company	Reference to sustaining innovations practiced	Reference to disruptive innovations targeted (-) or in process (*)
PCB09 national	Business model that is oriented toward quality control in the selection of raw materials, allied to the sustainability of operations.	Project to expand monthly production and new research for the application of waste in hygiene and beauty products; Industry 4.0 technology package to manage the company; innovation in the production process for malt drying; investment in bio-packaging and toxicity-free printed products.	* Research with the pharmaceutical industry for new beauty products; beer-based jelly to eat with a spoon; project to become the only one in the country to have a complete line of hygiene products and also to develop a system that will allow the company to identify the sale of products throughout the country and in real time, i.e., where it was sold, quantities and type of beer; project to test biological waste on bricks and tiles.
PCB10 state	Honest business model in the environmental sphere and with socially correct processes.	3D printing for new product labels; new formulas to produce beer with new flavors for different audiences, such as diabetic, hypertensive, and gluten-intolerant people.	- The COVID-19 pandemic reignited the company's flame to become better and seek new options in the market, with product differentiation, new formulas, and flavor combinations.
PCB11 local	Business model linked with technology and the circular economy to produce specialized beers and contribute to society by reducing the environmental footprint.	New flavors of low-alcohol "genuine lager beer"; promoting the company's sustainability with customers through marketing practices on menus.	* Developing new formulas for non-alcoholic, low-carb (reduced amount of carbohydrates and calories), and light (reduced alcohol content and calories) beers with combinations of hops, fruits, and seeds with an exclusive patent.

sustaining and disruptive innovations practiced, desired, or in process in their company (Table 5).

All 22 companies mentioned sustaining innovation as a promoter of business maintenance and as fundamental to the improvement of products and processes; the aim of sustaining innovation is to reaffirm and maintain their position in the market. Companies invest in product and process improvements through Industry 4.0 technologies, product combinations, quality control of the materials purchased, quality control of in-process products, quality control of process steps, marketing, and sustainability actions.

Regarding disruptive innovations as a strategy to offer new attributes to consumers, this is referred to by companies as a dream scenario and at the same time as an opportunity to establish themselves and position themselves in the market as a reference for all business models. Disruptive innovation is present in the discourse and indicates a path toward improvement because it shakes up companies' current plans, steering them toward the activation of new ideas. Companies that strive for disruptive innovation are those that feel restless and are looking for opportunities for leverage. They dream of disrupting the industry and making their company a benchmark.

All the actions of these companies focused on the circular economy and innovation are interconnected, promoting synergy and continuous improvement in the context analyzed herein. The companies stimulate and directly impact the transformation of business models, leading them toward circularity. Gastronomy is incorporated into the management of the brewing companies, just as brewing companies

are involved in the management of gastronomy. Decisions are taken together to combine the business strategies of brewing companies with the gastronomic strategies established in the 22 companies surveyed. Gastronomy is the branch of knowledge that encompasses cooking, beverages, materials used in food, and, in general, all cultural aspects associated with food products, as a cultural element, a symbol of identity, and a means of integration and construction of a specific identity for each social group (Charis, 2020).

3 | DISCUSSION

In the four types of disruptive innovation—product and service innovation, process innovation, business innovation, and management innovation (Christensen, 1997)—a parallel is established that positions Brazilian and Portuguese companies at different levels of maturity in terms of innovation. The Brazilian companies with a local scope (BCB01, BCB03, and BCB04) and the Portuguese companies PCB01, PCB04, and PCB11 refer to the management of innovation practices as unstructured and poorly defined, therefore positioning them at a non-existent level (0). The respondent from BCB01 commented that he dreams of introducing disruptive innovation and becoming a reference point in the craft beer industry, with specific reference to PCB04. The Portuguese company PCB07, which also conducts business locally, positioned itself at awareness level (1). This respondent commented that innovation practices are still poorly structured and

defined but pointed out that the company was founded on good principles and within the sustainable environmental concepts of Portuguese and European laws. Because of these factors, he believes that the first step for the company to initiate disruption was carried out at the beginning of the project. This allows for the promotion of significant and exponential improvements in performance or quality indicators.

The Brazilian companies BCB02, BCB05, and BCB08, which positioned themselves at awareness level (1), addressed the fact that the costs of innovation are high but are necessary to face market challenges. As reported by BCB02, the company always analyzes market events and competitors and maintains consistent conduct to ensure quality and improve products and processes. BCB05 pointed out that improving the quality of products and processes involves the introduction of new technologies that will allow the development of sustainable innovations optimized for their business model as well as disruptive innovations with the introduction of new conveniences to the market. Company BCB08 explained that it visited companies in the United States, Chile, and Argentina and used these visits to develop a plan for an innovative product with different packaging and sustainable criteria and the introduction of a statistical tool that will help in real-time measurements of the behavior of their formulations and will allow them to standardize the content and flavor of the batches produced and improve the company's position in the market.

Level (2), where the basic processes of innovation maturity are defined but remain obscure or simple, included the Brazilian companies with a business scope in the southern region (BCB06, BCB09, and BCB11) as well as the Portuguese companies PCB02 and PCB10, with their business scope at the state level. BCB06 commented that the goals for disruptive innovation remain low and unclear but mentioned that a strategic plan is being prepared together with an export plan and that these actions will promote the company in the national and international markets. For BCB09, innovations are allied with sustainability, and this respondent pointed out actions in new products that combine both factors, such as printing on bottle caps that will read "please recycle me" on cardboard packaging with the message "recycling is to help nature" and on beer kegs and vending machines the inscription "recycling is healthy and smart, do your part." BCB11 believes that innovation stimulates changes and points out a plan to attract investors and thus completely transform their business model. The Portuguese companies PCB02 and PCB10 commented that an innovative company mixes strategies with market opportunities to differentiate themselves with an unprecedented product or an innovative business that will shake up the competition and result in the dream of positioning themselves prominently throughout their national market.

Level (3) was selected by BCB07 and BCB10, which both have businesses with national coverage in Brazil, and by Portuguese companies PCB05, which has state-level business coverage, and PCB06 and PCB08, with business coverage in the northern region of Portugal. BCB07 and BCB10 pointed out that innovation is implemented in their strategic plan and the results appear through improvements in products and processes. BCB10 highlighted a disruptive

innovation that will appear through investments in a new product that will be called "vegan beer." This new product made without chemical additions at any stage will serve a portion of the female population and the fitness market that does not consume the company's products because they do not meet these requirements. The company believes that this approach will bring new positioning and growth to the sector, as innovations to serve new audiences, if they produce results, will be lasting and growing. This company is also positioning itself with a new factory to serve new regions of Brazil. The Portuguese companies PCB06 and PCB08 emphasized the elimination of problems and continuous improvement through new technologies and quality control of products and process steps. PCB06 develops new products using apple and Sicilian lemon to provide fruity flavors, and PCB08 is conducting research for the elaboration of a patented green beer and controlled origin.

At level (4), two Portuguese companies selected this level. PCB03 and PCB09 are businesses with national coverage in the Portuguese market, and their innovation maturity management systems are well incorporated, with the performance of these processes being predictable and goals achieved. PCB03 has patented exclusive products and services of the company and cited an example of access for partners who sell these products throughout the country. These partners have an access "login" that allows them to view the company's factory in real time and project images on screens. This practice helps in building loyalty, agility, and business standardization. PCB09 promotes disruptive innovation through research with pharmaceutical industries for new personal care products such as shampoos and conditioners and food products such as beer in the form of a jelly to eat with a spoon.

The results selected by these companies show that the stages of maturity of disruptive innovation in Brazilian and Portuguese companies are at various different stages, and it appears that the sustained level (5) does not occur in any of the 22 companies surveyed. According to the responses of all 22 companies regarding disruptive innovation, it can be gathered that the business scope factor can influence the path to the sustained level (5). Furthermore, it is evident that Portuguese companies with a national scope are positioned one level above Brazilian companies with the same national scope. Factors such as the level of sustainability established in the companies, smaller consumer market and demand for innovations in terms of flavors in smaller quantities, may have influenced the higher position of Portuguese companies with a national business scope.

For the Brazilian companies BCB01, BCB03, and BCB04 and the Portuguese companies PCB01, PCB04, and PCB11, symmetry is evidenced in the non-existent level (0) of disruptive innovation as well as the business scope at the local level, with the exception of PCB07, which is positioned at level (1). This is also seen with Brazilian companies BCB02, BCB05, and BCB08, with state-level coverage, and BCB06, BCB09, and BCB11, operating in the southern region, while Portuguese companies PCB02, PCB10, and PCB05 with state-level coverage and PCB06 and PCB08 in the northern region are positioned one level above the Brazilian companies of a similar scope. Factors such as producing greater quantities to the detriment of developing new flavors and the situation of companies not having a specific

person or department responsible for sustainability may have influenced the positioning of Brazilian companies.

The main or secondary craft brewing business models promote practical circular economy actions that allow companies to generate improvements in their technical and biological cycles and thus obtain additional value. With the idea that there is no end of product life and the consequences this has for the disposal of materials (Domenech et al., 2019), companies are encouraged to promote new applications for waste products from their production cycles and interrupt disposal practices.

The business model of the craft beer industry, which is part of the beverage business model, is positioned as an integrated model in the circular economy and is dependent on sustaining and disruptive innovations to create additional value for the company and society with new products and processes. These companies' positioning of their models toward creating additional value through the circular economy and innovations reflects the industry's concern to seek new product and process options in order to compete with traditional breweries.

The circular economy and sustaining and disruptive innovation are interconnected, promoting synergy and continuous improvement for the context of the companies surveyed. They stimulate and directly impact the transformation of models, leading them toward circularity (Figure 136). Gastronomy, in the context of the companies surveyed, is a driver and link between the constructs of the circular economy and innovations. Gastronomy is incorporated into the management of brewing companies, just as brewing companies are involved in the management of gastronomy. Decisions are taken together to combine the business strategies of the brewing company with their strategy toward gastronomy.

Gastronomy is the branch of knowledge that encompasses cooking, beverages, materials used in food, and, in general, all cultural aspects associated with it (Hegarty, 2009). Gastronomy, as a cultural element, is a symbol of identity and a means of social integration (Sormaz et al., 2016). It represents a set of cultural practices and is an element of social differentiation, as well as a practice that goes beyond the simple act of eating and drinking, contributing to the construction of a specific identity, typical of each social group (Charis, 2020).

Brazilian business models were created to produce draft beer and craft beer, and as a result of business evolution and market analysis, they incorporated the gastronomy business. These businesses realized that considering gastronomic aspects attracts customers, improves turnover, and thus triggers an increase in their production of beer.

Gastronomy is part of these companies' production strategies, promoting visibility of their processes and products and combining with the reuse of waste products from their production cycles. Brazilian companies perceive gastronomy as a selling point and consequently increase their production volume as a direct factor in creating new products and leading to their promotion and acceptance. In order to deliver new products, they perceive gastronomy as an ally in increasing the quantity produced, and they capture the perceptions and suggestions of customers to provide feedback to the company regarding improvements.

The Portuguese beer companies' business models were created as a second option in the context of the companies surveyed. These companies already had businesses, such as a hotel, bar, restaurant, or shop, and realized the market opportunities presented by the craft beer business. These brewing businesses, planned and implemented together with gastronomy, were incorporated into the main businesses and became another income stream and a means to promote their main business. The brewing business was thus born within sustainable contexts and aligned with the circular economy.

In the context of the Portuguese companies, they perceive gastronomy as a selling point and a way to improve the financial results of their main businesses, with the introduction of a diversity of flavors that will draw the consumer's attention and promote their secondary brewing business, together with their main business. They perceive gastronomy as an ally to deliver originality with sustainable actions and gather ideas for new combinations that promote consumer satisfaction and benefits for both their primary and secondary business models.

Gastronomy is the gateway to increasing income and employability, simultaneously combining with the circular economy and innovations to encourage business models to become circular. Even companies that pointed to impacts on their business from the COVID-19 pandemic point out that gastronomy helped them avoid greater losses. These 22 companies made investments in the gastronomic space during the pandemic period and designed new improvements to increase and optimize their turnover.

Gastronomy emerges in this scenario as a crucial business aspect that helps companies adapt to the multicultural social contexts of each country and area of coverage. Food-related practices are an essential aspect of human identity, and gastronomy carries with it a means of sustenance and integration in the context of the companies surveyed. These practices act as links between strategies and actions, as it is through them that the two constructs and drivers are interconnected.

Brazilian and Portuguese companies position themselves on the strategy that the more value an organization creates, the greater the probability of its being profitable and overcoming the challenges of the sector and the characteristics of each business model. The more value a business can provide to its customers, the greater its competitive advantage will be, and this will ensure the continuity and success of business models.

Brazilian and Portuguese companies point out different principles to create, deliver, and capture value and understand that they must promote additional value for the customer with concrete actions to create, deliver, and capture value. In terms of actions to create value, Brazilian companies point to a single formula including process control, individual characteristics of the company, and quantity of product. To deliver value, they consider the quality of the product at all stages, as well as originality, availability, and satisfaction for the consumer, and to capture value, they highlighted customers' sensory perceptions of their products, suggestions for improvements reported by customers, and the actions of competition.

Portuguese companies consider the creation of value in terms of process control, the individual characteristics of the company, and the diversity of products. In order to deliver value, they consider the quality of their products at all stages, product originality with sustainable actions, and consumer satisfaction. Finally, to capture value, they consider the sensory perceptions of their customers, suggestions for improvements reported by customers, and tips for new combinations of flavors. The actions taken to create a successful business formula are similar among all 22 companies, including process control, unique characteristics of the company, delivering product quality at all stages, consumer satisfaction, and actions to capture customers' sensory perceptions and suggestions for improvements.

Craft breweries tend to have a loyal, differentiated, and insatiable audience that are in a constant search for new experiences and discoveries. Companies invest in business models and help integrate a community that is passionate about craft beer, arousing the interest and curiosity of lovers of traditional drinks and brands and developing the production chain. They believe in business models for income generation and development and are passionate about what they do. This passion is expressed through making unique, tasty products, with quality standards to compete with the big brands and awaken in customers the desire and pleasure of consuming products imbued with authenticity and originality. They use the circular economy and innovations to generate continuous improvement, carry out quality management in their products and processes, and believe in sustainability as a decisive and guiding factor for their business.

For practitioners, this research adds a number of insights on how to improve the green performance of firms by circularity. First, this research sheds light on the circular economy practices that were adopted by a variety of organizations. This can add to a better understanding on the adoption of the circular economy, its challenges, and opportunities. It is possible to point out that say that the practices adopted by the researched organizations still add low value and are directly related to cost reduction and optimization. This signals valuable opportunities for those companies to be more ambitious by adopting more innovation to generate disruptions, new markets, and new niches of activity. As an example, production of by-products such as cookies from beer fermentation residue, soaps, and moisturizers, combined with nanotechnology and biotechnology, can generate innovative solutions for packaging—bioplastics, combined with nanoparticles, can generate durable materials for furniture.

For current businesses, this research provides insights for them to understand their levels of maturity and develop a plan to differentiate themselves as producers of circular greener craft beers.

The practical implications for brewery managers are associated with revealing the potential of their business to create by-products capable of generating greater monetary gains, better use of waste, and win-win opportunities. There are other latent potentials for craft beers that engage with circularity. In partnerships with a biomaterial laboratory, research centers specializing in biotechnology and nanotechnology can generate new ultra-innovative products capable of transforming the brewing sector at its essence.

4 | FINAL REMARKS

The objective of this article was to highlight the level of maturity of the circular economy in Brazilian and Portuguese craft breweries according to the ReSOLVE framework, as well as the maturity level of technical and biological cycles and sustaining and disruptive innovation. Regarding the circular economy maturity level and the ReSOLVE framework, we found that Brazilian and Portuguese companies are at different stages. The results do not allow the companies to be jointly positioned at a specific maturity level, and it appears that complete optimization of practices is not present in any of the 22 companies surveyed. It may be concluded that there is synergy between the maturity models of circular economy principles and practices and innovation. The higher the maturity level of circular economy practices, the greater the engagement with disruptive innovations, bringing originality and creating new markets and new segments of activity in the craft brewing context for the companies studied.

Both Brazilian and Portuguese companies internalize circular economy principles through the reuse, remanufacturing, and recycling of components in technical and biological cycles. Sustaining innovations are generally present in the routine of companies, impacting the dynamics of their products and processes, promoting continuous improvement, and allowing business continuity. These businesses apply controls to ensure the quality of products, processes, formulas, flavors, and packaging and redirect waste products from technical and biological cycles to new industrial applications and new products for human and animal food, hygiene, and beauty products. Among the disruptive innovations mentioned, software; combinations of flowers, fruits, and seeds for new flavors; and digital platforms for management stand out.

In terms of the maturity level of technical and biological cycles, the reality in Brazilian companies is similar to the Portuguese context, as both present optimization of practices that are integrated into management and daily activities to recycle, reuse, and reintroduce waste products. The results show that the maturity of technical and biological cycles among Brazilian companies is at the optimized level (5) in companies BCB02, BCB05, BCB06, BCB08, BCB09, BCB10, and BCB11 and is close to reaching the optimized level in companies BCB01, BCB03, BCB04, and BCB07. The Portuguese companies demonstrate fully optimized cycles (5).

Considering the maturity level of sustaining and disruptive innovation, brewing companies are unanimous in pointing out changes and affirm that such innovations promote improvements in the sector and encourage entrepreneurs, disrupting and leading them toward constant market analysis in order to develop innovations. Sustaining innovation is presented as a sustained practice (5) in the management of both Brazilian and Portuguese companies and is referred to as essential for the maintenance of business success and permanence in the market and is fundamental to customer preference. Considering disruptive innovation, Brazilian and Portuguese companies were found to be at different levels of maturity, and the results do not allow for the companies studied to be jointly positioned at a specific level;

furthermore, the sustained level (5) of these practices does not occur completely in any of the 22 companies surveyed.

The circular economy, alongside with sustaining and disruptive innovations, contributes to business models becoming circular. The interfaces between these factors show that practices and management strategies are targeting sustainability through innovations, and we conclude that there is synergy between the maturity models of circularity and innovation in Brazilian and Portuguese companies. The higher the circular economy maturity level, the greater the engagement with innovations, which generates originality, develops new business practices, and promotes the continuous improvement of craft breweries and gastronomy in general. All 22 companies highlighted the importance of the gastronomic aspect in the craft brewery business because it generates revenue, promotes employability, leads to continuous improvement of products, and brings theoretical strategies and practical actions together through investment, reintroduction of waste products from biological cycles for the production of human and animal food products, and financial resilience during the recession period imposed by the COVID-19 pandemic.

This work contributes to theory by highlighting the maturity levels of the circular economy according to the ReSOLVE framework, the maturity levels of technical and biological cycles, and the maturity levels of sustaining and disruptive innovations. In addition, this research contributes to the strategic thinking of companies by pushing them to consider changing their business model based on assessment of these maturity levels. For practitioners, we contribute by providing concrete evidence of sustaining and disruptive innovations, what strategies each company has developed, is developing, or intends to develop, as well as the performance of the brewing companies studied, which can serve as inputs for other segments and business models as a stimulus to adopt circular economy practices with sustaining and disruptive innovation.

For managers, this study indicates the potential for advances in value creation and innovation through the introduction of circular economy practices, in particular through product value retention and incremental and disruptive innovations, which are capable of generating attractive products and services for consumers.

Finally, a few limitations of this study must be mentioned. First, the two countries studied herein present different geographic and population characteristics, different experiences of the COVID-19 pandemic in different countries and companies, and different production volumes and business scopes of each company. Five potential avenues for future studies are therefore suggested. First, it is suggested that future research could replicate or expand the sample size to other geographic regions, as well as apply it to other business segments. Second, future studies could investigate how gastronomy can introduce new value to business models and create trends for product and process innovations, as well as consider the financial implications of disruptive innovations at the optimized level (5). The third recommendation is to explore interests and develop mechanisms that help companies to carry out innovative pilot projects to transform linear production chains into circular ones and create new beers for

national launch. (Of the 22 companies surveyed, 18 said they would be willing to participate in such research.) The fourth recommendation is to investigate stakeholder value chain-centric business models and innovations and how these can drive continuous improvement for resource circularity. The fifth and final recommendation refers to technical and biological cycles and suggests research into maturity levels in other business models, since the components of these cycles differ between business models.

CONFLICTS OF INTEREST

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements) or non-financial interest (such as personal or professional relationships, affiliations, knowledge, or beliefs) in the subject matter or materials discussed in this manuscript.

AUTHOR CONTRIBUTION STATEMENT

Dulcimar José Julkovsky: planning, research, report, analysis, and funding. Simone Sehnem: planning, research, reviewing, analysis, and funding. Maria da Conceição Pereira Ramos: research and reviewing. Charbel Jose Chiappetta Jabbour: reviewing, analysis, and funding.

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