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Fostering circular economy through open innovation: Insights from multiple case study

Francesco Antonio Perotti[1,2] | **Augusto Bargoni**[1,3] | **Paola De Bernardi**[1] | **Zoltan Rozsa**[3,4]

[1]Department of Management, School of Business and Economics, University of Turin, Torino, Italy

[2]Department of Management, School of Business and Law, University of Agder, Kristiansand, Norway

[3]European Centre for Business Research, Pan-European University, Prague, Czech Republic

[4]Faculty of Social and Economic Relations, The Alexander Dubcek University of Trencin, Trencin, Slovak Republic

Correspondence
Francesco Antonio Perotti, Department of Management, School of Business and Economics, University of Turin, Corso Unione Sovietica, 218bis, Turin, Italy.
Email: francescoantonio.perotti@unito.it

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Abstract

This study represents an empirical, comprehensive investigation of two different inter-organisational collaborative approaches, offering a novel perspective on collaborative circular business models in the modern economy. In this vein, we explore how open innovation strategies foster the implementation of circular economy practices within a circular supply chain and a circular ecosystem. In addition, we identify and characterise stakeholders' roles in facilitating the translation of circular principles into a viable business. An inductive theorising approach was employed, leveraging an explorative multiple case study methodology. Data were collected from 13 organisations involved in two collaborative networks, designed to establish upcycling practices to recover waste from the food and beverage industry. A critical realist philosophical positioning underpinned researchers' data collection and analysis. As a result, we outline the nature of two different collaborative approaches to pursue a regenerative production system through open innovation strategies: a circular supply chain and a circular ecosystem architecture. The characterisation of the coordinator and orchestrator of collaborative circular business models is also highlighted in our findings. In sum, this study contributes to the literature on circular economy by unveiling the role of open innovation in fostering circular business development. From a practical standpoint, it offers insights for managers of sustainability-oriented companies willing to implement upcycling practices.

KEYWORDS
circular business model, circular economy, collaboration, ecosystem, innovation, open innovation, supply chain, upcycling

1 | INTRODUCTION

Circular economy (CE) represents a highly discussed topic that has attracted the interest of policymakers, foundations, researchers and companies committed to a thriving and sustainable future. Drawing on this approach to sustainability, the key to unlocking environmental and human well-being lies in a renewable production and consumption system, where resources are constantly re-employed, resulting in waste reduction and minimising environmental corruption (Bocken et al., 2016; Ellen MacArthur

Foundation, 2013; Pieroni et al., 2019). Accordingly, sustainable-sensitive organisations are gradually translating their practice and processes to conform with the CE principles by giving rise to circular business models (CBMs).

Companies have proved to be crucial in driving the transition from a linear to a circular approach, due to the propensity to innovate the business model in pursuit of efficient resource management, cleaner production and long-lasting and recyclable products (Aranda-Usón et al., 2020; Geissdoerfer et al., 2020; Konietzko et al., 2020; Sousa-Zomer et al., 2018). However, looking at the grand challenges that contemporary society is facing (e.g. climate change, resource depletion, food security and nutrition and biodiversity loss), the current endeavour seems to be deficient (Alonso-Munoz et al., 2022; Food and Agriculture Organization of the United Nations et al., 2022; United Nations, 2021b). For example, the world is currently 7.2% circular, and this rate is supposed to double by 2032 to avoid climate collapse (Circle Economy, 2023). It is also worth mentioning how global food waste from households and the agri-food industry is around 1 billion tonnes each year (United Nations, 2021a), besides nutritional imbalances and hunger (Food and Agriculture Organization of the United Nations et al., 2022). In the European Union, nearly 20% of the whole agri-food production is wasted or lost (European Commission, 2020). Overall, 360 million tonnes of scrap material originate from retail and food service throughout the world, which also implies a waste of energy resources used in the production processes, as well as the environmental impact of wastage in terms of a carbon footprint (United Nations, 2021a, 2021b). Building upon this background, we consider the food and beverage sector as fully sensitive to circular conversion in order to expand knowledge about the establishment of recovery practices in collaborative CBMs. These conditions relentlessly pose new challenges for policymakers, foundations, academics and managers in emphasising their efforts to support sustainable development (European Commission, 2020; Organisation for Economic Co-organisation and Development, 2020; Pizzi et al., 2020; United Nations, 2021b).

The extant literature advocates how CE offers an effective approach to achieve environmental ecosystem regeneration and long-term sustainable development (Averina et al., 2022; Bressanelli et al., 2022; Geissdoerfer et al., 2020; Konietzko et al., 2020). However, several barriers hinder the development of CBMs. In fact, earlier studies have highlighted how sustainability-oriented innovations demand a great amount of knowledge and collaboration, with the consequent need to approach and build partnerships with other organisations to develop circular processes and products (Appleyard & Chesbrough, 2017; Bogers et al., 2020; Brown et al., 2020; Enkel et al., 2009; Jabeen et al., 2022). From this perspective, inter-organisational and cross-industry interactions have been recognised as facilitators of circular business development, but the literature still falls short in addressing stakeholders' relationships and collaborative mechanisms that lead to the development of collaborative CBMs (Bocken & Ritala, 2021; Brown et al., 2021; Khan et al., 2020; Santa-Maria et al., 2022).

Strategic alliances can facilitate the development of circular practices favouring supply chain collaboration and alignment in terms of technical and processual coordination towards actors' involvement in sustainable innovation development (Brown et al., 2021; Leising et al., 2018). By resource sharing, such as knowledge, companies go beyond competition to establish a collaborative environment characterised by knowledge sharing routines that support business interactions with a proper communication platform and knowledge channelling, as well as supporting effective governance (Chaudhuri et al., 2022; Köhler et al., 2022). Open innovation (OI) practices associated with inbound, outbound or coupled strategies have been shown to foster the innovative efforts of circular businesses and to deal with technological and technical barriers that stand in front of circular process implementation and product development (Jesus & Jugend, 2023; Madanaguli et al., 2023; Moggi & Dameri, 2021; Strazzullo et al., 2022). While a debate around this issue has begun among academics and practitioners, it represents an initial attempt to shed light on the complex dynamics regarding CE and IO intertwinement.

Building on this theoretical gap, numerous interesting insights can be derived by studying the parallels between OI approaches and sustainability (Bertello et al., 2023; Chesbrough & Di Minin, 2014; Ghisetti et al., 2015; Kennedy et al., 2017). While the concept of a closed environment in which research and development (R&D) activities take place with limited opportunities for exchange and interaction has been overshadowed, there has been a rise in interactive network dynamics where organisations go beyond their boundaries to gather ideas, projects and technologies that can be used to innovate (Bogers et al., 2017; Chesbrough, 2003; Enkel et al., 2009). In this regard, the OI paradigm is shaped around a disruptive concept of the origination and implementation of ideas within the company's innovation process through external input (Appleyard & Chesbrough, 2017; Bogers et al., 2020). On the basis of this background, this study focuses on the strategic link that ties sustainability-oriented actors within two collaborative networks to unveil how OI strategies can support companies in embracing CE through upcycling (e.g. Aarikka-Stenroos et al., 2022; Leising et al., 2018; van Hal et al., 2019).

By employing a multiple case study approach, this article unravels how inbound, outbound and coupled processes can overcome barriers to the implementation of CBMs. Consistent with the inductive nature of this study, we adopted a critical exploratory approach to collect and analyse data from our observation of a circular supply chain and a circular ecosystem architecture (Bygstad et al., 2016; Lawani, 2021; Piekkari et al., 2009; Welch et al., 2022). Specifically, we analysed primary and secondary data from 13 companies, including private and public entities operating in the food and beverage, nutraceutical, cosmetics and manufacturing industries (Camilleri, 2021; Cavicchi & Vagnoni, 2022; De Bernardi et al., 2023; Venturelli et al., 2022). As a result, the examination of two circular networks revealed the effectiveness of IO strategies in implementing upcycling practices within companies, demonstrating how collaborative CBMs leverage critical resources

and diverse expertise to drive circular-oriented innovations. Our findings also unveil the collaborative mechanisms and distinctive role assumed by focal actors in the circular supply chain and the circular ecosystem.

In summary, this study addresses the clear need to examine in more detail the benefits of strategic collaborations and OI strategies on collaborative CBMs. Building on the theoretical tenets offered by the resource-based view (Barney, 1991; Grant, 1991), besides the insights suggested by the stakeholder theory (Freeman, 1994, 2010; Parmar et al., 2010), we contribute to theory highlighting the intricate interplay between resources, knowledge and stakeholder relationships in achieving a competitive advantage and sustainable value creation across multiple dimensions. Enriching the eco-innovation literature at the intersection of CE and OI (Bocken & Ritala, 2021; Jesus & Jugend, 2023; Köhler et al., 2022), our multiple case study emphasises the role of OI strategies, cross-supply chain alliances and cross-industry collaborations in fostering circular-oriented innovations (Bertassini et al., 2021; Moggi & Dameri, 2021; Tapaninaho & Heikkinen, 2022). In addition, this study provides insightful managerial implications to encourage collaborative approaches to address the CE transition, in order to address grand challenges through a renewable and restorative economic approach.

This article is organised into six sections. After the introduction in Section 1, Section 2 presents the theoretical underpinnings of the study, which led to the development of the research questions. Then, Section 3 describes the research design and the methodology we adopted, followed by the presentation of the results in Section 4. Section 5 provides a comprehensive discussion and Section 6 includes concluding remarks regarding the limitations of the study and future research avenues.

2 | THEORETICAL BACKGROUND

2.1 | The intertwining of circular economy and open innovation

The CE paradigm has become popular for many industries to build CBMs and to boost eco-innovation development (Geissdoerfer et al., 2017; Koszewska, 2018; Suchek et al., 2021). In this vein, the CE transition, from a linear model to a CBM, represents an innovation-intensive process of business re-organisation (Averina et al., 2022; Bocken et al., 2016; de Jesus & Mendonça, 2018; Perotti et al., 2023; Sharma et al., 2021). In the domain of innovation studies, the interconnection of environmental and social concerns alongside the need to foster economic growth has led academics to find different approaches to achieve corporate sustainability (Chesbrough & Di Minin, 2014; Ghisetti et al., 2015; Lin & Zheng, 2016), introducing the concept of eco-innovation. It is defined as 'new or improved socio-technical solutions that preserve resources, mitigate environmental degradation and/or allow recovery of value from substances already in use in the economy' (de Jesus & Mendonça, 2018, p. 77). In this regard, change is triggered by technical knowledge derived from the rise of sustainable innovations that enable firms to adopt new modes of sectoral organisation or new business configurations (Cillo et al., 2019; Jabeen et al., 2022; Johnson & Suskewicz, 2009; Pieroni et al., 2019).

By leveraging innovation management across multiple stakeholders, collaboration plays an essential role in overcoming the linear production system and fostering CBMs (Brown et al., 2021; Jesus & Jugend, 2023; Khan et al., 2020; Leising et al., 2018). In fact, CBMs entail cross-sectoral collaboration (Hazen et al., 2021; Witjes & Lozano, 2016) fuelled by a systemic approach that enables partnerships, knowledge sharing and collaboration to develop a competitive advantage (Borland et al., 2016; Köhler et al., 2022; Le et al., 2023). This system is propelled by the adoption of OI as a distributed process based on purposively managed knowledge flows across organisational boundaries (Bertello et al., 2023; Chesbrough & Bogers, 2014; Pan et al., 2023). OI appears to be the key approach to face the complexity and systemic nature of today's societal challenges and to foster the transition towards a more sustainable and digital economic model (Bertello et al., 2023).

The transition towards a CBM is indeed jeopardised by several barriers that prevent its adoption (de Jesus & Mendonça, 2018; García-Quevedo et al., 2020; Hina et al., 2022; Jabbour et al., 2020; Jaeger & Upadhyay, 2020; Kumar et al., 2019; Urbinati et al., 2021). More specifically, among those barriers academics pinpoint technologies as the most prominent but also find a lack of knowledge, ability and capacity among employees, and a lack of information about product design and production to enable the development of environmentally and sustainable products (de Jesus & Mendonça, 2018; Jabbour et al., 2020; Ritzén & Sandström, 2017; Shahbazi et al., 2016). Due to the collaborative nature of CE, academics have postulated that firms might benefit from the adoption of OI practices to mitigate the technological and technical barriers that prevent the implementation of CBMs (Brown et al., 2020; Jesus & Jugend, 2023; Venturelli et al., 2022). In a seminal work, Chesbrough (2003) defined OI as a concept that entails companies' exploitation of internal and external ideas to improve and accelerate their innovation processes, at the same time making their ideas, knowledge and technologies available to the external market environment. Accordingly, through exposure to different stakeholders, communities or ecosystems, companies evolve their business model (Camilleri, 2022; Jesus & Jugend, 2023; Konietzko et al., 2020; Strazzullo et al., 2022). The three types of OI knowledge flows (i.e. outside-in, inside-out and coupled processes) to which the firm is exposed actively facilitate the company's ability to acquire and disseminate critical knowledge, leveraging inter-organisational collaboration to enhance innovation processes.

In conclusion, OI represents a key factor in driving CBMs which, through waste recovering from the value chain, provides companies with tangible benefits such as lower material cost and diminished resource dependence (Lewandowski, 2016; Urbinati et al., 2017). Companies interacting via CE networks thus benefit from inter-organisational resource sharing, increasing their chances of developing successful, circular-oriented innovations (Blomsma et al., 2023; Brown et al., 2020; Miranda et al., 2023). As a result, the intertwining

of CE and OI paves the way to shape different forms of cooperation among actors in circularity-oriented collaborative models.

2.2 | Disclosing collaborative circular business models

Considering the typical resource strategies of CBMs (i.e. narrowing, closing and slowing loops), Bocken and Ritala (2021) highlighted two innovation approaches characterised by distinct strengths and weaknesses. On the one hand, a closed innovation approach ensures more control and coordination of the entire innovation process but, on the other hand, an open approach to circular-oriented innovation allows organisations to gather and leverage more capabilities and resources (Appleyard & Chesbrough, 2017; Bogers et al., 2020; Brown et al., 2020; Enkel et al., 2009). In support of the second innovation path, previous research suggests that collaboration among several organisations may be an enabling and stimulating factor for CBM establishment (Bocken et al., 2016; Mishra et al., 2019; Rizzi et al., 2013; Sarja et al., 2021; Sohal & De Vass, 2022). Furthermore, some empirical studies have shown how the development of circular ecosystems or circular supply chains represents a solid base for the implementation of circular businesses based on new circular-oriented innovations, optimising resource employment and environmental ecosystem functioning (Bressanelli et al., 2019; Kanda et al., 2021; Konietzko et al., 2020; Venturelli et al., 2022). As described by Greco et al. (2015), the interface separating an organisation from external entities like its partners, sources of innovation or licensees can be likened to a partially permeable membrane. Knowledge moves across this boundary to varying extents and speeds (Fey & Birkinshaw, 2005). These degrees and rates of knowledge transfer can be affected by several factors, including the nature of the knowledge itself (whether it is easily codified and transferable), the dynamics of the relationships involved (long-term relationships tend to facilitate exchange) and the inherent characteristics of the organisation and the stakeholders. In this regard, collaborative innovation has been discussed in previous studies, though the CE literature still falls short of specifically addressing the OI strategies in CBM innovation processes (Jesus & Jugend, 2023; Köhler et al., 2022). Researchers are gradually acknowledging the precise role of inter-organisational collaboration in enhancing the establishment of circular businesses, as well as the effects of stakeholder interdependencies on value creation and similar potential factors that may condition such an approach to sustainability.

Drawing from the CE literature, academics have proposed that inter-organisational collaboration is a critical factor in developing circular-oriented innovation. In fact, Brown et al. (2019, p. 3) defined circular-oriented innovation as 'the coordinated activities that integrate CE goals, principles, and recovery strategies into technical and market-based innovations, such that the circular products and services that are brought to market purposively maintain product integrity and value capture potential across the full life-cycle'. While circular-oriented innovation is a novel and little-understood concept, we can identify, in the collaborative innovation literature, some antecedents to the adoption of such innovation models (Veleva & Bodkin, 2018). In fact, the literature shows that the primary motive for exploring collaborative innovation is the increase in knowledge flows (Appleyard & Chesbrough, 2017; Bogers et al., 2017, 2020). Other reasons that push companies to adopt such models are the increased competitiveness and the market share of innovations, the access to resources or to new markets or the acquisition of new skills (Bocken & Ritala, 2021; Brown et al., 2019). However, circular-oriented innovation exposes the firm to opportunistic behaviours of the partners involved in the process (Pouwels & Koster, 2017). The potential partners involved in circular-oriented innovation must be aligned in terms of vision and sustainability policies to overcome the possibility of reputation pitfalls.

At the systemic level, in the same direction of circular-oriented innovation, academics have defined a circular ecosystem as 'a system of interdependent and heterogeneous actors that go beyond industrial boundaries and direct the collective efforts towards a circular value proposition, providing opportunities for economic and environmental sustainability' (Trevisan et al., 2022, p. 292). On the other hand, previous studies identified collaborative CBMs from the observation of the coordinated adoption of CE practices by the actors gathered around the same value chain (Butt et al., 2023; De Angelis et al., 2018; Lahane et al., 2020). Circular supply chain management, as 'the integration of circular thinking into the management of the supply chain and its surrounding industrial and natural ecosystems' (Farooque et al., 2019, p. 884), has been recognised as a collaborative approach to pursuing circular-oriented innovations (Brown et al., 2019). Overall, a significant stream of literature focuses on the use of OI strategies to develop sustainable innovations (Bogers et al., 2020; Chistov et al., 2021; Rauter et al., 2019). Recent studies have approached open environmental innovation from various angles. For example, Mothe and Nguyen-Thi (2017, p. 2) defined open environmental innovation as the pursuit of external knowledge through practices like information sourcing, R&D acquisition and knowledge-sharing strategies. Another perspective, provided by De Marchi and Grandinetti (2013, p. 571) and Spena and Di Paola (2020, p. 3), characterises open environmental innovation as a strategic approach aimed at supplementing 'internal investment in green-specific resources with knowledge and competences coming from network partners' to foster eco-innovation. In summary, these definitions highlight several key aspects of open environmental innovation. First, it primarily seeks to reduce the environmental impact of organisations. Second, it places a significant focus on access to external physical and financial resources to foster information and knowledge exchange.

Through the theoretical lenses of the resource-based view (Barney, 1991; Chaudhuri et al., 2022; Muench et al., 2022), we posit that collaborative efforts within networks play a pivotal role in facilitating the transition to CBMs (Miemczyk et al., 2016), fostering sustained growth and gaining a competitive edge (Rodrigues et al., 2021). In the domain of supply chain and procurement research, the natural resource-based view theory has been

recognised as a valid framework for understanding the link between sustainability-related resources, capabilities and a firm's competitive advantage (AlNuaimi et al., 2021; Andersen, 2021; Giacomarra et al., 2021; McDougall et al., 2022). Its application in the domain of CBMs (Farooque et al., 2022; Kusumowardani et al., 2022; Schmidt et al., 2021) allows one to investigate the antecedents of the CBM network structure, particularly supplier selection, as a fundamental component of sustainable supply chain management. The natural resource-based view theory, originally introduced by Hart (1995), represents an evolution of the resource-based view proposed by Wernerfelt (1984). The resource-based view suggests that companies develop their capabilities based on underlying resources to attain a competitive advantage. These resources must simultaneously be valuable, rare, inimitable and non-substitutable (Barney, 1991), and the firm must have a strategy in place to leverage these resources and capabilities (Grant, 1991). The focus of this theory centres on internal, non-transferable organisational resources, such as assets, capabilities, processes, information and knowledge (Eisenhardt & Martin, 2000). In contrast, the natural resource-based view expands this perspective by incorporating the interaction between a firm and its natural environment, encompassing three interconnected strategic capabilities critical for achieving both business and environmental sustainability, and thereby securing a competitive advantage: pollution prevention, product stewardship and sustainable development (Hart & Dowell, 2011).

Moreover, when firms utilise collaborative business models, their cooperative strategic approach can be examined using the perspective of stakeholder theory (Freeman, 2010; Freeman et al., 2010). This cooperative strategic approach characterises a preference within companies to view their stakeholders as potential collaboration partners, rather than adversaries, as outlined by Strand and Freeman (2015). It is not just a matter of recognising that the interests of all stakeholders are interconnected and mutually dependent, but also that the relationships between firms and their stakeholders should exhibit this interdependence and mutual connection. In their seminal work, Adner and Kapoor (2010) described how business ecosystems are value-oriented networks composed of a number of heterogeneous stakeholders that are connected by transactions. Hence, the concept of ecosystem is used to describe the collaboration between different but complementary organisations that cooperate to create common system-level values (Bertassini et al., 2021; Jacobides et al., 2018). The development of these system-level values contributes to promote the development of radical and disruptive innovations in sectors that have the potential to grow and disrupt the current business and activities (Bertassini et al., 2021; Geels, 2012). Business ecosystems foster dynamic cooperation around innovations (Jacobides et al., 2018; Moore, 1993), leveraging network-oriented and externally focused perspectives to boost business scalability (Fuller et al., 2019). While disruptive innovations are usually complex and require stakeholders with shared values, the business ecosystems fill this gap by fostering the development of new capabilities within the network to foster cooperation and value capture (Kramer & Pfitzer, 2016).

In conclusion, addressing the CE transition requires companies to innovate at a higher rate by cooperating in a network, as opposed to operating as isolated units. Thus, OI processes play a central role to boost the adoption of circular practices by lowering technological barriers, such as a lack of knowledge, the availability of technical solutions and the modifications required to product projects and production processes (de Jesus & Mendonça, 2018; Ovuakporie et al., 2021; Ritzén & Sandström, 2017). Based on this theoretical background, we aim to empirically address how CE-oriented businesses establish inter-organisational partnerships and collaborations to engage in OI, as a strategy to introduce circular practices. In addition, we seek greater clarity in terms of strategic approaches to establish collaborative CBMs by closely studying a circular supply chain and a circular ecosystem architecture in addressing the CE transition. Thus, we are guided by the following research questions (RQs).

RQ 1: How do inter-organisational collaborations foster the adoption of CE strategies in companies?

RQ 2: What are the commonalities and differences between a circular supply chain and a circular ecosystem architecture as collaborative approaches to address the CE transition?

3 | METHODOLOGY

To understand how sustainability-oriented companies apply CE principles through strategic alliances, the present empirical study has followed an inductive theorising approach characterised by a multiple case study design. Based on the definition advanced by Eisenhardt (1989, p. 534), we refer to the case study methodology as a 'research strategy which focuses on understanding the dynamics present within single settings'. Thus, the intent is to 'examine, through the use of a variety of data sources, a phenomenon in its naturalistic context, with the purpose of confronting theory with the empirical world' (Piekkari et al., 2009, p. 569). Inductive theorising proved to be a fitting approach because we are dealing with an event characterised by unsatisfactory theoretical explanations (Edmondson & McManus, 2007). In this vein, previous studies have highlighted the need for additional empirical investigations aimed at building grounded theory to unravel stakeholders' inter-organisational relationships while addressing a circular transition (Jesus & Jugend, 2023; Khan et al., 2020; Köhler et al., 2022). Therefore, according to Yin (2014) and Eisenhardt (1989), we have relied on a multiple case study design to investigate such contextually embedded phenomena.

Drawing on Welch et al. (2022), the research design follows an alternativist philosophical approach. Accordingly, this multiple case study places an emphasis on causal explanation and explanatory contextualisation of the cases via a holistic, not variable-oriented, approach (Ragin, 1992). The critical realism lens offers a different point of view for qualitative research: a case study explanation does not pass through the identification of potential cases for generalisation; rather, it is focused on explaining the mechanisms that give

rise to a phenomenon (Easton, 2010; Lawani, 2021; Ragin, 1992). As such, the content's richness and an extensive analysis of the selected cases are privileged during the investigation. Thus, the theorising process is inclined to be a case-oriented explanation, to enhance a holistic and detailed causal and relational representation of the cases under investigation (Piekkari et al., 2009; Ragin, 1997). As an effective manner to build theory from a grounded phenomenon, we focused on tracing the causal process that brings about results in terms of CE strategies in the observed contexts (Bygstad et al., 2016; Strauss & Corbin, 1997).

3.1 | Sample selection

Considering the intention to investigate a sample of firms prone to the adoption of CE principles, we employed purposeful sampling to select cases that would best represent the establishment of a collaborative CBM leveraging the interactions of multiple actors (e.g. Ciulli et al., 2020; Köhler et al., 2022; Leising et al., 2018; Perotti et al., 2023; Zucchella & Previtali, 2019). This approach allowed us to delve into two potentially insightful and relevant empirical cases, from which we could abstract grounded theory and contribute to the extant literature by answering our research questions (Eisenhardt, 1989; Santa-Maria et al., 2022; Strauss & Corbin, 1997). In particular, we considered the food and beverage sector because it provides one of the best realities to deepen OI dynamics within circular-oriented businesses, where companies interact with profoundly heterogeneous organisations and advance cross-industry collaborations (Bargoni et al., 2022; Cavicchi & Vagnoni, 2022; Ferraris et al., 2020; Venturelli et al., 2022). The choice of this domain also comes from the urgency of promoting circular businesses aimed at reducing waste and rethinking resource usage (i.e. virgin materials, water, energy) to act against environmental corruption (Alonso-Munoz et al., 2022; De Bernardi et al., 2023; European Commission, 2020; Konietzko et al., 2020; United Nations, 2021a).

More specifically, this study is based on the observation of two separate collaborative settings (i.e. a circular supply chain and a circular ecosystem architecture), where different entities come together to translate CE principles into feasible practices through upcycling. First, we selected two companies operating in the food and beverage industry (Company A and Company H) and then extended the investigation to their stakeholders. As a result, the two case studies involve 13 companies based in Italy. We collected data from seven companies from the circular supply chain of Company A, and six organisations operating in the circular ecosystem orchestrated by Company H (Table 1). Given our intention to advance an in-depth investigation of contextualised phenomena (Easton, 2010; Piekkari et al., 2009; Ragin, 1992; Welch et al., 2022), the number of businesses we considered is thoroughly satisfactory based on previous comparable studies (Averina et al., 2022; Zucchella & Previtali, 2019).

3.2 | Data collection

According to the philosophical reasoning of this qualitative study, the approach to data collection evolved with the natural progression of the research (Piekkari et al., 2009; Ragin, 1992). In the first stage, an extensive preliminary desk investigation yielded various insights regarding the identification of sustainability-oriented actors suitable for the study. The core of data collection is then represented by in-depth individual and group interviews administered to the leading members of the selected organisations, supported by additional information from supplementary sources.

TABLE 1 Descriptive information of the sample.

Collaborative approach	Organisation	Industry	Size	Interviewee(s)
Circular supply chain	A	Food and beverage	Micro	Chief executive officer, business and product development
	B	Commerce	Large	Supply chain and innovation manager
	C	Commerce	Large	Supply chain manager
	D	Food and beverage	Small	Chief executive officer
	E	Food and beverage	Small	Chief executive officer
	F	Food and beverage	Small	Chief executive officer
	G	Food and beverage	Small	Chief technology officer
Circular ecosystem	H	Food and beverage	Medium	Chief executive officer, production manager, marketing manager
	I	Chemical	Medium	Chief executive officer, product manager
	J	Manufacturing	Small	Chief executive officer
	K	Pharmaceutical	Medium	Chief executive officer, head of research and development and business development
	L	Food and beverage	Small	Chief executive officer
	M	Research and education	Large	Scientific head and research team

Source: Authors' elaboration.

More precisely, we initially explored the strategic interactions among the circular-oriented entities by conducting four open-ended interviews with managers and leading members of the two focal companies (Company A and Company H) to assess the eligibility of the cases. This preliminary investigation was complemented by performing painstaking exploratory analysis of the relational dynamics established by the two key companies with their respective stakeholders. We designed the interview protocol to be more flexible and open in the first group surveys; while it changed to semi-structured interviews once we had identified the target companies to be studied. This second step involved 16 semi-structured interviews administered to managers and highly informed participants of the organisations involved in the strategic partnership. We included these subjects in the data collection process due to their decision-making role in circular product development and circular process establishment, as output of the inter-organisational collaboration. This approach provided us the opportunity to gather information about the companies' circular practices by keeping the conversation within chosen boundaries while leaving openness for the participants to explore relevant aspects and experiences (Kvale, 1996; Timmermans & Tavory, 2012). We interpreted the data that emerged from the interaction between the interviewers and the interviewees based on our high level of reflexivity and extensive knowledge (Silverman, 2015).

In practice, the interview guide addressed the research questions in the form of a semi-structured conversation (see Table 2 for the detailed interview guide). Overall, we administered a total of 20 open-ended group and individual semi-structured interviews either in person or through virtual meetings from July to December 2022.

TABLE 2 Semi-structured interview guide.

Questions
1. What does circular economy mean to you? Are you familiar with the circular economy principles? What process or practice have you implemented, or do you plan to implement, in this sense?
2. How did your commitment to the circular economy rise and/or evolve? Did you develop a circular process, product or service? If so, is it a result of product/process innovation?
3. How important are the other actors (e.g. companies, public entities, foundations) in the definition of a circular-oriented innovation that enables the establishment of a circular business?
4. Did you have all the required capabilities, knowledge and structures internally, as well as access to sensible resources, to launch the circular practice? Or did you experience knowledge and resource channelling/exchanges through the involvement of other actors (e.g. companies, public entities, foundations)?
5. Has this led to the generation of new innovations or knowledge from which all actors have benefited in terms of their approach to the circular economy?
6. From your point of view, what is the advantage of undertaking an open innovation approach to leverage the interactions among different stakeholders in addressing the circular economy transition?
7. Did you recognise any risks associated with the dissemination of internal knowledge to other organisations/realities?

Source: Authors' elaboration.

Each individual or group colloquium lasted between 35 min and 1 hr, and was recorded by mutual consensus of the participants. During the entire data collection process, we gathered some secondary material from websites, public reports and company communications. In seeking situated explanations, we decided to rely on different sources to analyse information about the two case studies from different points of view and to elaborate on a contextualised explanation of the events (Easton, 2010; Flick, 2004; Lawani, 2021; Welch et al., 2022). Data triangulation allowed us to outline a more detailed view of the structures of the two multi-actor collaborations (e.g. Ranta et al., 2018; Santa-Maria et al., 2022). We deemed data collection to be complete when theoretical saturation was reached (Corbin & Strauss, 2007; Marshall & Rossman, 2014; O'Reilly et al., 2012).

3.3 | Data analysis

Before addressing the data analysis process, it is worth mentioning our meticulousness in applying the present methodological approach. Findings' validity and reliability have been ensured by taking some precautions suggested by renowned authors (e.g. Corbin & Strauss, 2007; Gibbert et al., 2008; Marshall & Rossman, 2014). We designed the interview guide by drawing on similar questionnaires adopted in comparable qualitative empirical analysis in the CE literature (Aranda-Usón et al., 2020; Hofmann & zu Knyphausen-Aufseß, 2022). In addition, we involved the participants in theme validation and interpretation while we interviewed them. The data collection process included a triangulation phase in which we combined empirical observations from the participants with various sources of information (Flick, 2004). This approach ensured better comprehension of the cases, alongside a holistic explanation of the interests that facilitate the interactions that allow companies to build circular-based collaborations (Gibbert et al., 2008; Marshall & Rossman, 2014; Yin, 2014). We also ensured the accuracy of the results with an intercoder comparison and discussion to ensure the accurate interpretation of data. Thus, we addressed intercoder reliability by assessing the agreement of the authors regarding the interpretation of the data collected via multiple sources for the two case studies (O'Connor & Joffe, 2020; Potter & Levine-Donnerstein, 1999; Schwanholz & Leipold, 2020).

While collecting data, we started the systematisation process and analysis of the information gathered from multiple sources. The interviews were transcribed and complemented with field notes and support documents, extracted from websites and company reports. Then, we coded the data and interpreted it based on our experience. As an exploratory qualitative analysis, it was not our intention to look for common patterns among the cases (Bygstad et al., 2016; Ragin, 1992; Silverman, 2015; Welch et al., 2022). Wearing the critical realist lens, we explored the two cases from different actors' perspectives to aggregate each point of view in the respective inter-organisational relational network. In this way, we observed the positioning of the organisation in the circular supply chain and in the circular ecosystem to achieve a more accurate analysis and

description of the case from the actors' perspective. To add more value to the data analysis, we sought causality representation of the intertwined set of interactions and interdependencies among the actors, while designing inter-organisational collaboration to induce product or process innovation for circularity (Timmermans & Tavory, 2012; Welch et al., 2022). The two case studies allowed us to unpack the network of relationships and resource exchanges that have contributed to structuring the two collaborative configurations. The data analysis then moved from exploring the two collaborative architectures embedded in their context to their comparison. We performed a cross-case inquiry (e.g. Blomsma et al., 2023; Ranta et al., 2018) to offer commonalities and differences between the two collaborative approaches in dealing with the CE transition (Piekkari et al., 2009; Yin, 2014).

4 | RESULTS

The analysis of the case studies allowed us to identify two strategic collaborative approaches to foster CE implementation in companies. In both cases, OI proved to be the key to unlocking CE strategies by embedding upcycling practices in businesses. We present the main findings of our exploratory analysis in the following sub-sections, outlining how a circular supply chain and a circular ecosystem architecture represent empirically validated approaches for businesses to achieve sustainable development by leveraging OI practices.

4.1 | Circular supply chain for waste as resource

The first case study describes how the establishment of partnerships across the food value chain can boost the adoption of circular practices based on the transformation of waste material into new secondary raw resources. The founding of an innovative start-up (Company A), characterised by the mission to reduce food waste and its environmental impact in the form of lower CO_2 emissions, represents a pivotal point in the creation of the circular supply chain. As stated by the chief executive officer (CEO):

> [Company A] was created with the aim of reducing food waste on the planet. Following the principles of circular economy, we established an upcycling process to reintroduce recovered food waste back into the production process.

Thus, Company A's business model has been built upon the sustainability-oriented objective to coordinate resource recovery from unsold goods and production wastage (i.e. bread, pasta offcuts and exhausted barley malt) to attribute their new value as inputs for other production processes (i.e. beer and snacks). The key element in fostering a circular supply chain lies in the partnership established by the aforementioned innovative start-up with upstream and downstream stakeholders. These include bakeries (such as Company F), HoReCa operators (such as Company E), a pasta manufacturer (Company G), large-scale retail trade operators (such as Company B and Company C) and a small beer producer (Company D) who joined Company A's circular project (see Figure 1).

Through the exploitation of waste-as-resource materials among partners in the food and beverage industry, three main circular processes can be outlined that give rise to as many circular products. By recovering surplus food in the form of bakery waste from HoReCa operators (such as Company E), bakeries (such as Company F) and large-scale retail trade operators (such as Company B and Company C), suppliers' unsold bread is processed by Company A to obtain barley malt and yeast. Similarly, offcuts from pasta production of Company G are also recovered by Company A as barley malt. These secondary raw resources are employed as inputs for craft beer production, administered in conjunction with the brewing Company D. The latter gives rise to innovative circular products in the form of two kinds of premium craft beers. In this way, there is a reduction in raw materials fed into the production cycle, which corresponds to about one third of the barley malt used in the production of beer, besides the waste reduction in the food industry and its environmental impact. Then, brewing leaves residues in the form of spent barley malt, commonly known as threshing barley. After processing, it is depleted of sugars yet still rich in protein, fibre and mineral salts. The recovery of spent barley malt results in an input material that contributes to the production of another innovative circular product (i.e. a baked snack). As such, scrap from beer production is further processed by Company A to become new input in the production of baked snacks, taken over by the bakery Company F. This approach allows replacing almost half of the virgin raw resources used in snack production, leading to food industry waste reduction and lower emissions, alongside fewer virgin materials entering the production cycle. Finally, the channel to market these circular-based products is facilitated by the downstream stakeholders operating in large-scale distribution (Company B and Company C), besides the e-commerce operated by Company A and other partners that sell the product via their online shops. For example, Company G's online marketplace offers the beer that has been made by employing its pasta offcuts.

Overall, the circular supply chain structure allows scrap collection (i.e. bread, pasta offcuts, and exhausted barley malt) and recovery into higher value secondary raw materials (i.e. barley malt, yeast and spent barley malt containing minerals, fibre and protein), which are then used to realise premium circular products (e.g. craft beers and snacks). While preventing food and beverage industry scraps and food surpluses from being disposed of or sold off as animal feed ingredients, the collaborative effort of multiple companies has enabled innovative circular processes to leverage waste as a resource for circular product development. As a result, the circular supply chain's output is represented by three main offerings that reach the market: two kinds of premium craft beers and baked snacks.

Commitment to corporate sustainability and CE principles has inspired and strengthened the organisations' willingness to build new relationships among one another, yet the main coordinator has been

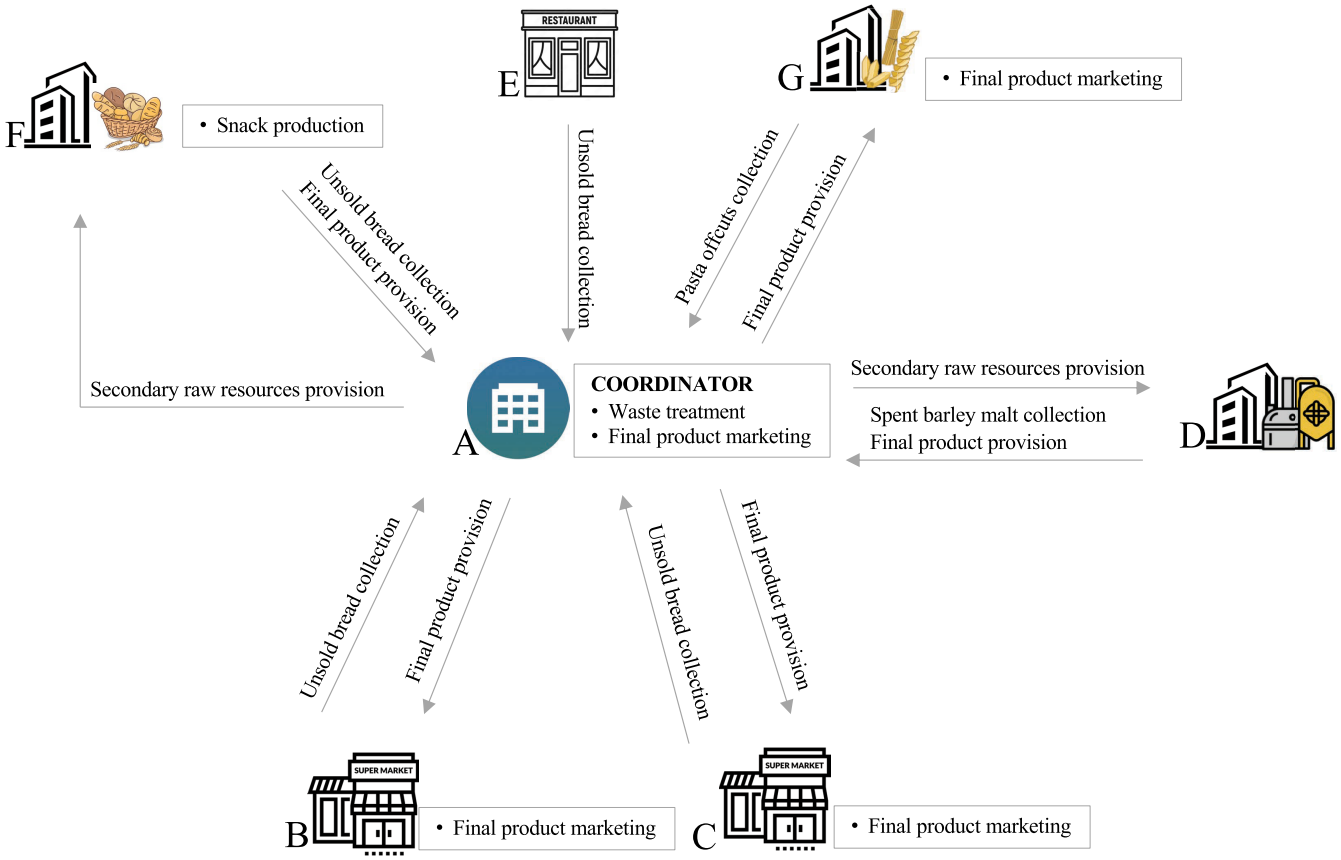

FIGURE 1 Graphical representation of the circular supply chain. *Source*: Authors' elaboration.

Company A. It is positioned between manufacturers and retailers and has played the role of central coordinator of the circular supply chain as a forward-looking company that recognises opportunities through the CE transition. As a coordinator, Company A has acted as an intermediary among heterogeneous realities by connecting them for the collection, recovery, processing and utilisation of waste as new resources. These partnerships outline flexible, medium-term-oriented linkages within the circular supply chain, where the actors create value out of the resources and knowledge gathered to shape circular processes and products. More specifically, we observed how Company A has acted as the central node of the circular supply chain by controlling the flow of resources and knowledge, as well as coordinating activities and the OI strategies in connection with other actors. The exchange has not been limited to the provision of resources and market outlets for circular products. Indeed, the most important element is represented by the knowledge gathered from different actors and conveyed into the development of innovative circular processes and products. In line with the evidence collected from the CEO of Company A, the chief technology officer of Company G and the CEO of Company D agreed that knowledge gathering is a fundamental element to enable circular-oriented innovation:

> We only have a fraction of the know-how required to undertake the upcycling process. Knowledge of an innovative nature meets more technical know-how to build innovation for circular economy.

While Company A has dealt with the collection of food waste as the coordinator of the circular supply chain, the processing of the surplus and product development activities has required more technical capabilities. Company A is more familiar with CE principles and CBM innovation, which is the reason why it has acted as a coordinating figure in the circular supply chain. However, purely innovative know-how and awareness of CE principles have been complemented by operational and technical know-how related to material recovery and the development of circular products. The connection among the actors has ensured an exchange of knowledge that has shaped the OI strategy behind upcycling. More precisely, Company A's internal knowledge related to CE has been complemented with knowledge about waste features from bakeries (Company F), HoReCa operators (Company E), the pasta manufacturer Company G and large-scale retail trade operators (Company B and Company C), besides the expertise offered by the beer producer Company D, to shape an innovative circular process that effectively converts unsold bread into secondary raw material input for beer production. Similarly, Company A has coordinated the knowledge and resource exchange between the pasta manufacturer (Company G) and the beer producer (Company D) to design a feasible circular process that allows pasta offcuts to be recovered into beer

production components. In both cases, the actors have taken advantage of inside-out and outside-in OI strategies to gather awareness of circular practices, specific technical know-how related to bread and pasta and technical expertise from the beer producer, to figure out how to leverage waste as new resources. An open collaborative environment has also been the key to recover spent barley malt: Company A has promoted process innovation to treat beer production scrap by drawing on Company D's waste awareness and Company F's experience in developing bakery products. As a result, the strategic alliance has leveraged OI strategies to overcome technical barriers to CE transition to develop circular-oriented innovations aimed at cycling waste from bakery and pasta value chains into secondary raw resources for the beer and baked snack value chains. Therefore, the coupling strategy in an open collaborative environment has favoured the recombination of the companies' internal knowledge with the external expertise and know-how provided by the other actors towards co-creating innovative processes and circular products. Complementary partners have combined inbound and outbound OI strategies with the aim of developing recovery processes to employ waste-as-resource materials in new circular products. In this direction, the CEO of Company A has supported the importance of strategic alliances in achieving circularity:

> If a company wants to achieve circularity, it is essential that there is collaboration with other entities. Synergy among different actors is important, otherwise the circularity discourse in entrepreneurship remains somewhat "crippled", partial, or does not express its full potential.

From the insights offered by this case, we can conclude that a circular supply chain formation based on OI practices underpins the effective implementation of CE strategies. It offers the basis for narrowing, slowing and closing the resource loop by recovering waste from a value chain to reduce the resource input of similar value chains.

4.2 | A local circular ecosystem for higher quality recovery

The second case study illustrates that five companies operating in different industries, yet belonging to the same local context, have established a circular ecosystem based on waste valorisation with the support of a public entity. More specifically, the companies operating in the food and beverage (Company H and Company L), chemical (Company I), pharmaceutical (Company K) and manufacturing (Company J) domains have succeeded in establishing upcycling practices, also thanks to the joint effort of the local Research Institute M. These sustainability-oriented companies have set up a strategic alliance among private and public entities, arranged according to an interactive and collaborative environment where OI strategies are leveraged to achieve higher quality recovery of industrial waste (see Figure 2).

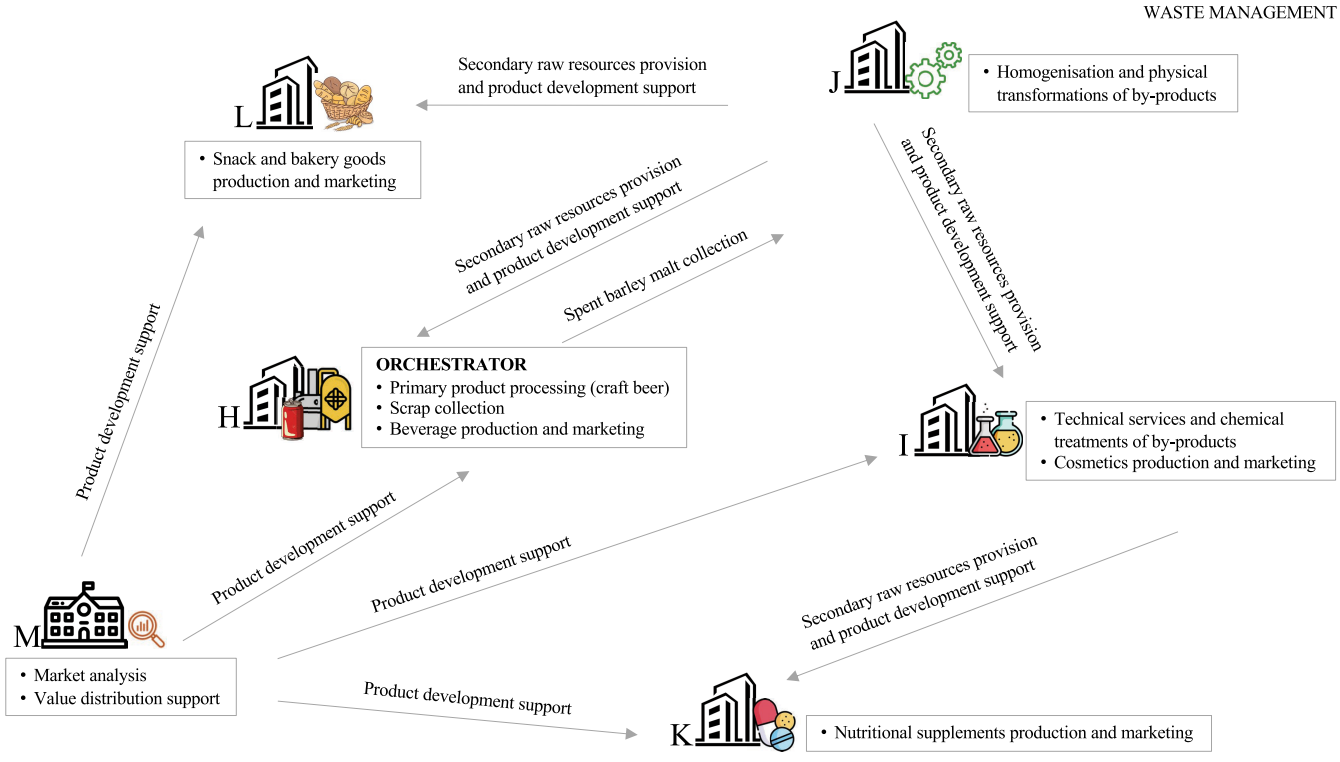

FIGURE 2 Graphical representation of the circular ecosystem architecture. *Source*: Authors' elaboration.

The CEO of Company H, the leading actor of the circular ecosystem architecture, clearly outlined the underlying purpose of the strategic alliance as follows:

> The circular economy is not just about reducing businesses' environmental impact and achieving zero waste production, but also about leveraging unexploited valuable resources identified in processing steps. These are approaches that are well suited for food companies, as well as for other industries.

In this vein, the circular ecosystem architecture is based on the optimisation of waste recovery from craft beer production. Grain and barley malt processing leaves scraps in the form of spent barley malt, from which the brewery extracts starches to provide fermentable sugars for the yeast, but other precious nutrients are still present. While such waste materials are partially absorbed by the animal feed industry, this initiative has pursued extracting nutrients from beer production scraps to take advantage of the residual substances in spent barley malt before being disposed. Hence, recovery processes inspired by the CE principles allow organisations to extract valuable resources from waste, which represents secondary raw materials for the realisation of innovative circular products such as baked goods, beverages with specific features, nutritional supplements and cosmetics.

In practice, Company H deals with the processing of primary goods (i.e. craft beer), producing spent barley malt as production scrap. To extract the residual valuable nutritive elements from such waste, Company J is involved in the transformation of exhausted malt through homogenisation and physical processing into recovered raw material, along with the support of Company I for chemical transformations and technical services. By combining their know-how in food processing and chemical treatments, useful substances—plant-based proteins, nutritional fibres (including arabinoxylans), beta-glucans and a sweetener obtained by refining and condensing water juice derived from beer production (i.e. starch milk)—can be successfully extracted from spent grain. Secondary raw material retrieval is potentially expendable in circular product development, resulting in a reduction in virgin raw material input in business processing. Then, such recovered resources are introduced as input in innovative circular product development by four companies belonging to the circular ecosystem. First, Company H takes advantage of the sweetener recovered from starch milk to realise a sugar-free line of innovative beverages. This company also uses plant-based proteins in the production of non-alcoholic beverages characterised by a high protein levels, while beta-glucans and fibres (i.e. arabinoxylans) are applied to develop innovative non-alcoholic beverages designed to reduce the amount of sugar and cholesterol absorbed by the digestive system and thus cardiovascular disease. Second, Company K employs beta-glucans and arabinoxylans to produce nutritional supplements that assist the intestinal microbiome and support the immune system, as well as supplements designed to prevent heart disease and diabetes. As a bakery, Company L benefits from using recovered plant-based proteins to produce functional snacks. The company also uses the sweetening agent as input in sugar-free festive bakery products for diabetic consumers. In addition to dealing with the chemical treatment of by-products, Company I includes a substance obtained from dried and pulverised spent barley malt as a secondary raw resource in the production of cosmetics (especially hand and body lotions). Acting across the board, Research Institute M conducts the market analysis and consumer investigations that support the circular product design by the companies. As a result, the recovery of nutrients from spent barley malt, before being sold off as food for breeding animals, allows the companies to jointly develop a wide range of innovative circular products (i.e. beverages, nutritional supplements, lotions and baked goods). Such circular products are meant to be sold by their respective manufacturers but, as outputs of the circular ecosystem, the actors' agreement ensures a fair distribution of the value created. In this vein, in addition to being responsible for market analysis to support the development and launch of the new circular products, Research Institute M has been appointed to administer the value creation and delivery link among the partner companies. Therefore, this case depicts how a circular ecosystem architecture allows companies to create shared value from waste recovery and circular product development by leveraging upcycling practices.

The circular ecosystem architecture has enabled collaboration among the stakeholders towards the development of circular processes aimed at recovering valuable resources from waste materials. In this case, Company H represents the outstanding actor that has led the circular transition project by acting as the orchestrator of the strategic alliance. As the circular ecosystem orchestrator, Company H has built trust and commitment among the businesses and entities involved, besides promoting communication among the actors and a shared vision towards win-win-win opportunities related to CE. In this vein, Company H has promoted the inclusion of actors in the ecosystem and their interaction, encouraging and facilitating their exchange of knowledge and resources. The circular ecosystem architecture in this case is characterised by continuous brainstorming among the main figures of the parties involved. Each actor provides unique knowledge and expertise to shape innovative processes, to extract valuable elements from brewing waste, and to outline innovative uses of recovered resources according to their businesses. As stated by the CEO of Company J, in agreement with the CEOs of Company H and Company I, during a group interview with Research Institute M:

> No company has a predefined role. We have different backgrounds and expertise, the integration of which allows us to outline viable paths for translating circular principles into feasible processes.

An open environment enables process and product innovation by leveraging a local circular ecosystem architecture, where companies cooperate to reduce virgin material employment and production waste. Awareness of CE practices acts as a guideline for the entire ecosystem, to which the actors from heterogeneous domains have added their specific know-how and technical capabilities. Company G's CEO

supports the interaction among the multiple actors in the circular ecosystem architecture:

> The need to bring in multiple and heterogeneous actors results in having more specific expertise. This makes it possible to achieve a circular economy ecosystem that cuts across the value chains of multiple industries.

More specifically, a combination of outside-in and inside-out strategies has allowed Company H to share awareness about CE principles and to acquire technical know-how from Company J and Company I to co-develop a circular process to recover residual nutrients from beer production waste. Company H's familiarity with spent barley malt has been complimented by Company J's expertise in dealing with organic products, which in turn has been supplemented by the chemical treatments advanced by Company I. Thus, the companies have been able to conduct tests on the waste elements by using Company J's machinery to jointly define an innovative process capable of extracting the desired resources. As a result, we found that inbound OI strategies are again the key to co-developing innovative circular products from recovered resources. Companies H, I, K and L have come up with product innovations by identifying the applicability of by-products within their specific fields, supported by the market insights offered by Research Institute M. Overall, circular product development has resulted from the specific understanding of beverages, cosmetics, pharmaceutical and bakery markets, besides the waste awareness of Company H and the active support of Company I and Company J that have engaged in input material predisposition for product manufacturing.

This second case also demonstrates that OI has been the key to advancing innovative circular processes to extract nutrients and to design innovative circular products with a reduced environmental footprint. Such OI strategies are part of the circular ecosystem architecture: private and public actors from different industries interact in a vibrant, locally embedded environment to gather resources, know-how, expertise, technological tools and production facilities and to translate CE principles into long-term sustainable businesses.

4.3 | Cross-case analysis: Outlining commonalities and differences

In sum, our exploration of two inter-organisation collaborative settings has shed light on how companies leverage OI to put CE principles into practice. Both the circular supply chain and the circular ecosystem architecture have taken advantage of inbound and outbound strategies to enable circular business development through upcycling practices. Opening up the innovation process through multi-stakeholder strategic alliances has resulted in a successful approach to overcome technical barriers related to waste material recovery, as well as to design innovative circular products that include secondary raw resources rather than sourcing virgin materials. However, when looking at stakeholders' interactions and the administration of critical resources and knowledge flows, the two collaborative approaches display some commonalities and differences.

While we addressed the development of innovative circular processes and products through the interaction of multiple actors, we found substantially different entities operating within the circular supply chain and the circular ecosystem. The former specifically includes manufacturers and retailers of various sizes that belong to compatible supply chains in the food and beverage domain. In this vein, circular supply chains seem to be focused on a vertical collaborative setting that leverages the actors' extensive knowledge about the common industry. On the other hand, the circular ecosystem architecture has welcomed companies and a public entity from a wide range of sectors that brought more heterogeneous know-how and expertise into the strategic alliance. Leveraging cross-industry partnerships is a strength in the development of circular processes and products, qualifying the ecosystem as an exchange environment where harnessing profoundly different resources and knowledge provides a source for OI strategies. The pronounced pattern of interaction among the actors has unlocked innovation opportunities in the food and beverage domain, thanks to chemical extraction processes and physical transformation treatments that have enhanced waste recovery. Compared with the circular supply chain, the circular ecosystem architecture is also characterised by the local context where heterogeneous companies and public entities are involved due to their territorial proximity. As a locally embedded circular network, the circular ecosystem architecture demonstrated a more intensive exchange of critical resources and knowledge among the actors, resulting in strengthened OI processes.

Other common elements of the investigated cases include the presence of an outstanding actor, a company that typically holds a central role in the network by acting as a facilitator for stakeholders' interactions and as a catalyst for collaborative ventures. More specifically, we identified these figures as the coordinator of the circular supply chain (i.e. Company A) and an orchestrator of the circular ecosystem architecture (i.e. Company H). In the first case, the activities of the enterprises revolve around a central actor who coordinates the entire circular supply chain. The interactions among stakeholders to define circular processes and products are usually one-on-one, where the coordinator directly interfaces with a downstream or an upstream stakeholder. On the other hand, we found that in the circular ecosystem architecture, there is a stronger involvement of each actor around decision-making and innovation processes. The orchestrator represents a leading actor that fosters trust and commitment among the other entities involved while facilitating stakeholders' interactions without centralising critical resources and knowledge flows.

In addition, we noted an interesting distinction when closely analysing the two collaborative approaches in the distribution of the economic value created by circular businesses. This economic value includes the revenue generated from selling circular products to consumers, the reduction in virgin raw material inputs into the production process, and the net expenses associated with recovering secondary raw resources and logistics. In the first case, the

actors belonging to the circular supply chain are linked by supplier–customer relationships and the distribution of value is based on the trade negotiation of by-products and final goods between the coordinator and the other companies. Considering the collaborative approach based on a circular ecosystem architecture, value distribution relies on an agreement designed to equally share the economic value created from the circular processes. To guarantee the success of this initiative, Research Institute M has been entrusted with administering the economic value allocation among the other economic actors to ensure fair remuneration for engaging in CE practices.

Overall, the cross-case analysis led us to conclude that the circular ecosystem involves greater interaction among stakeholders and a more intensive exchange of resources compared with the circular supply chain. At the same time, the circular ecosystem architecture shows better cohesion and alignment among the actors based on a long-term perspective.

5 | DISCUSSION AND IMPLICATIONS

As a result of our exploration of collaborative CBMs, our findings include two comparable collaborative approaches, albeit with some distinguishing elements. In both cases, we observed that the adoption of OI processes has resulted in the integration of CE strategies in businesses. Consistent with previous research that has emphasised the role of OI in fostering business sustainability (e.g. Bogers et al., 2020; Camilleri et al., 2023; Kennedy et al., 2017; Rauter et al., 2019), this study empirically explored inside-out and outside-in strategies as even more important while dealing with circular-oriented innovations. Indeed, the innovations underlying circular products or processes entail several barriers and technical challenges due to waste manipulation for recovery, design and implementation complexities; financial support and market acceptance (Brown et al., 2020; García-Quevedo et al., 2020; Hina et al., 2022; Jaeger & Upadhyay, 2020; Kumar et al., 2019; Urbinati et al., 2021). These issues lead companies to transcend their boundaries and to advance strategic collaborations with other entities to acquire critical resources and knowledge and to foster the implementation of more effective and wide-ranging sustainable practices (Bogers et al., 2020; Brown et al., 2021; Carraresi & Bröring, 2021; Jabeen et al., 2022). Our findings support that, without embracing collaborative sustainable innovation, it would not have been possible to achieve the same results due to the highly complex and demanding domain. Echoing Appleyard and Chesbrough (2017) and Bogers et al. (2017), CBMs benefit from collaborative innovations to enhance their knowledge flows, besides accessing critical resources or new markets as suggested by Brown et al. (2019) and Bocken and Ritala (2021).

Following the literature reviews by Jesus and Jugend (2023) and Suchek et al. (2021), where the authors highlighted the link between OI and CE, our exploratory multiple case study complements Köhler et al. (2022) in depicting a cross-supply chain and cross-sectoral collaboration as instrumental in putting upcycling strategies into practice. More specifically, we focused on stakeholders' interactions and their collaborative mechanisms to promote innovative circular processes and products (Mishra et al., 2019; Zucchella & Previtali, 2019), according to two different collaborative approaches. Drawing on previous studies that advanced the concept of a circular supply chain (e.g. Aarikka-Stenroos et al., 2022; Bressanelli et al., 2019; Farooque et al., 2019; Kusumowardani et al., 2022), our results concur in outlining its characteristics and how it can lead to the development of collaborative CBMs. The circular supply chain has proved to be a strategic approach where companies advance cross-supply chain collaboration within a specific industry. As a result, this collaborative approach has successfully supported OI strategies by leveraging industry-specific knowledge to take advantage of waste as resource in premium circular product processing (Ellen MacArthur Foundation, 2013; Geissdoerfer et al., 2020; van Hal et al., 2019). On the other hand, our findings from the second case study supplement previous studies that have presented circular ecosystems as more participatory and interactive collaborative approaches, which involve heterogeneous actors from various sectors (e.g. Bertassini et al., 2021; Kanda et al., 2021; Konietzko et al., 2020; Zucchella & Previtali, 2019). In contrast to the circular supply chain formation, the IO processes are more intensive and have allowed the actors to leverage knowledge from the chemical and manufacturing fields to support the recovery and use of by-products in the food and beverage domain (Moggi & Dameri, 2021; Tapaninaho & Heikkinen, 2022). This implies a greater orchestration effort, as well as the need for a more structured scheme for value creation and distribution strategies (Bertassini et al., 2021; Parida et al., 2019; Zucchella & Previtali, 2019). Furthermore, the circular ecosystem architecture has leveraged the territorial proximity of the actors to support their interaction and exchange of critical resources and knowledge (Moggi & Dameri, 2021).

Additionally, our findings highlight the importance of outstanding actors in circular networks. The observation of the coordinator and orchestrator roles provided valuable insights into their distinct functions and contributions to fostering collaborative CBMs. These companies, which hold a central role in collaborative CBMs, act as a catalyst for stakeholders' interactions and facilitate the flow of essential resources and knowledge. In this vein, circular supply chain coordinators and circular ecosystem architecture orchestrators are fundamental in leveraging OI mechanisms for collaborative CBM development. In the context of circular supply chains, the coordinator mainly operates within a focused, industry-specific domain. This role primarily revolves around integrating and managing interactions among stakeholders within the supply chain. In this vein, coordinators facilitate resource flow, knowledge exchange and market access, playing a pivotal role in aligning efforts towards circularity. Their influence lies in administering inter-organisational exchanges, optimising material utilisation and streamlining processes to reduce waste generation while promoting the circular use of resources. As a result, we supplement previous studies such as Carraresi and Bröring (2021) and Hansen and Revellio (2020) by outlining some characteristics of focal actors in circular supply chains. On the other

hand, the orchestrator of a circular ecosystem architecture operates in a more expansive, cross-sectoral landscape. Orchestrators function beyond industry boundaries, encouraging collaboration among diverse stakeholders from various sectors. They focus on fostering trust, enabling open communication and facilitating collective decision making among heterogeneous entities. Orchestrators are pivotal in ensuring fair resource distribution, promoting equitable value sharing and creating an environment that encourages multi-industry innovation and sustainable practices. Based on previous studies that recognised the presence of a focal actor in circular ecosystems (e.g. Ferrari et al., 2023; Parida et al., 2019; Trevisan et al., 2022; Zucchella & Previtali, 2019), we have enriched the knowledge about the role of the orchestrator figure in circular ecosystems. Overall, these findings contribute to understanding the diverse roles played by coordinators in supply chains and orchestrators in ecosystems, shedding light on their unique functions and behaviours in driving collaborative networks towards the CE transition.

In the following subsections, we summarise the theoretical contributions and managerial implications of this study.

5.1 | Theoretical contributions

Building on the resource-based view perspective (Barney, 1991, 2010; Grant, 1991; Sehnem et al., 2022), we illustrated through two collaborative approaches how different organisations leverage rare and valuable resources and critical knowledge to achieve circular-oriented innovations. Complementing previous studies (e.g. Chaudhuri et al., 2022; Farooque et al., 2022; Kusumowardani et al., 2022; Muench et al., 2022; Schmidt et al., 2021), our research emphasises the significance of internal and external resource employment in CBMs, as well as the assimilation of diverse expertise across industries, as fundamental drivers in creating and sustaining competitive advantage within the realm of CE initiatives. Specifically, we contribute to theory by showcasing the intricate interplay between resources and knowledge in collaborative networks in addressing barriers to the CE transition. In alignment with the principles of the resource-based view theory, these collaborative endeavours elucidate the importance of unique and non-substitutable resources such as specialised knowledge of waste treatment processes, technological capabilities for material recovery and cross-industry expertise in driving circular-oriented innovations.

Moreover, the integration of such resources and knowledge in collaborative CBMs contributes to enriching the stakeholder theory applied in the business ethics domain (Freeman, 1994; Parmar et al., 2010; Tapaninaho & Heikkinen, 2022), which frames multiple interconnected entities collaborating to create and deliver value across economic, social and environmental value (Freudenreich et al., 2020). The empirical evidence from our study aligns with the fundamental tenets of stakeholder theory (Freeman, 2010; Freeman et al., 2010) by illustrating the intricate relationships and interactions among various stakeholders in both the circular supply chain and the circular ecosystem architecture. Our findings emphasise that the successful implementation of circular-oriented innovations is contingent upon not only acquiring critical resources and knowledge but also promoting robust relationships and collaborations among stakeholders (Moggi & Dameri, 2021; Tapaninaho & Heikkinen, 2022). In the examined cases, the central figures demonstrate how stakeholder relationships and inclusive collaboration serve as catalysts for achieving shared goals and value creation. The stakeholder theory lens also enhances our understanding of these collaborative endeavours by highlighting the importance of equitable value distribution and fair remuneration among the stakeholders, with particular reference to the circular ecosystem. In essence, our study underlines how the integration of diverse stakeholders, their resources and knowledge in collaborative endeavours not only drives circular-oriented innovation but also fosters sustainable value creation across multiple dimensions.

Drawing on these theoretical milestones, we enrich the literature regarding eco-innovation (Chesbrough & Di Minin, 2014; Cillo et al., 2019; de Jesus & Mendonça, 2018; Ghisetti et al., 2015) at the intersection of CE and OI (Bocken & Ritala, 2021; Jesus & Jugend, 2023; Köhler et al., 2022; Suchek et al., 2021). Our exploratory multiple case study contributes to depicting how OI strategies foster collaborative CBMs, specifically focusing on stakeholders' collaboration mechanisms and critical resources and knowledge exchange to co-develop circular-oriented innovations (Brown et al., 2020; Konietzko et al., 2020). Besides, we emphasise the importance of cross-supply chain and cross-industry strategic alliances in further enhancing the effectiveness of OI practices in collaborative CBMs (Bertassini et al., 2021; Moggi & Dameri, 2021; Tapaninaho & Heikkinen, 2022). As the first empirical study that has compared a circular supply chain and a circular ecosystem architecture, we also managed to highlight the commonalities and differences between collaborative approaches to stimulate new contributions in this regard. In addition, we advocate a new taxonomy for focal actors in circular networks (Carraresi & Bröring, 2021; Hansen & Revellio, 2020; Parida et al., 2019; Zucchella & Previtali, 2019).

5.2 | Practical implications

From a practical standpoint, this study offers valuable insights for chief sustainability officers and general managers of sustainability-oriented companies. Although this research deals specifically with the food and beverage industry, the lessons learned from the empirical investigation can be adopted analogously in other domains. Such guidance is meaningful in steering organisations towards adopting CE practices that not only minimise environmental impact but also foster a circular, restorative approach in their production systems.

Overall, this study provides valuable insights into how companies can successfully implement CE practices and establish CBMs by leveraging strategic collaborations. Both case studies highlight the significance of OI in fostering CE strategies; thus, managers should focus on creating an environment that encourages collaboration and the sharing of knowledge and resources beyond organisational

boundaries. In this sense, we suggest engaging in strategic alliances to capitalise on external critical resources, know-how, expertise and capabilities, as well as to provide internal knowledge to co-develop circular processes and products. As a result, the adoption of OI practices can effectively mitigate barriers to CE transition by enabling collaborative problem solving to overcome technical issues, reducing costs and risk in R&D processes, accessing a wide range of expertise from various sectors and disciplines, enhancing resource efficiency and creating new market opportunities.

Then, this study highlights how the adoption of collaborative approaches, such as a circular supply chain or a circular ecosystem architecture, can further intensify OI mechanisms. The first case study emphasises the importance of building partnerships across the value chain. Accordingly, managers should seek to establish relationships with upstream and downstream stakeholders, focusing on waste reduction and resource recovery. On the other hand, the second case highlights the benefits of forming circular ecosystems involving public entities and private organisations from multiple industries. We specifically recommend managers look beyond their immediate industry and consider cross-sector collaborations to create innovative circular solutions. This approach can lead to the development of unique products and services while maximising resource efficiency. Particularly concerning the circular ecosystem architecture, companies should consider interacting with local actors and institutions to leverage close connections for creating more effective CE practices.

As the presence of a focal actor proved to be crucial in developing collaborative CBMs, managers can also take inspiration from this study and strive to make their companies a central figure in the circular network. Otherwise, they are recommended to endeavour to establish strong relationships with the actors recognised as coordinators or orchestrators of the circular network.

In conclusion, an interesting aspect of these cases is how they handle the distribution of economic value created from circular processes. Managers should monitor value creation from CE practices and consider how such value is shared among stakeholders, ensuring fair and equitable distribution to maintain long-term partnerships.

6 | CONCLUSIONS AND FUTURE AVENUES

In summary, we adopted a multiple case study methodology to investigate how CE practices can be fostered by OI strategies. We explored two collaborative approaches, both dealing with waste recovery and secondary raw resource inclusion in innovative circular products. Through our analysis, we have shed light on a circular supply chain and a circular ecosystem architecture by outlining their commonalities and differences as collaborative CBMs.

Despite our firm commitment to ensuring the rigour of our research, we must highlight some limitations. The first one is represented by the small number of cases. Although our findings are not necessarily generalisable, in line with our critical realist philosophical positioning, we intended to prioritise a deep exploration of the two cases containing multiple observable entities. In response, future studies could further extend the investigation of these collaborative approaches to assess OI's role in fostering business circularity based on a larger sample. Another notable limitation lies in the absence of detailed industrial accounts from the observed cases. Future research would benefit from exploring the distribution of value among the various actors involved in these circular networks. Such an investigation could reveal insights into which participants gain the most benefits from circular-oriented innovations, providing a clearer understanding of the economic dynamics within circular networks. Moreover, delving into the dark side of circular practices in companies and circular networks could provide an interesting perspective for future research. Sustainability is commonly seen as a positive concept in the business management domain, due to the 'naturalisation' of the phenomenon in companies (Adler et al., 2007, p. 126). Thus, future studies could deal with the other side of the coin by investigating the effective economic and environmental sustainability of upcycling processes through complex and extremely elaborate circular practices for waste recovery.

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The authors declare no conflicts of interest that could potentially bias the results of the research or the conclusions presented in the article.

DATA AVAILABILITY STATEMENT

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ORCID

Francesco Antonio Perotti https://orcid.org/0000-0002-4719-7774
Zoltan Rozsa https://orcid.org/0000-0002-5748-5702

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