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RESEARCH ARTICLE

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Circular business model innovation and cognitive framing: Addressing the "missing micro"

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Abstract

Circular business model innovation is an important driver for the implementation of circular economy across industries and has become one of the central research debates in recent years. However, while macro-, meso-, and organizational level factors influencing circular business model innovation have attracted vast research interest, less is known about micro-, individual level factors. The question driving this paper is how do individuals' cognitive frames of sustainability influence their conceptualization of new circular business models? We argue that the notion of cognitive frames can help to address the problem of how individuals respond to new concepts with which they are unfamiliar, such as circular business models. The study is based on a multi-stakeholder project Alpha (anonymized), which involved circular business model innovation for resource recovery from waste. Findings suggest that cognitive frames are of primary importance for sensemaking of circular business models and can influence sustainability aspects considered for value creation, value delivery, and value capture.

KEYWORDS
circular business model innovation, circular economy, cognitive frames, multi-stakeholder collaboration, resource recovery from waste, sustainability

1 | INTRODUCTION

Societies face complex multifaceted and difficult sustainability challenges if they are to simultaneously attain economic benefits, positive impacts for the natural environment, and social justice. Practitioners and scholars have been increasingly interested in the role of circular economy and new business models in enabling sustainable development. Organizations in different industries integrate circular economy principles into their business models to use natural resources more effectively by narrowing, slowing, and closing resource loops and eliminating waste (Despeisse et al., 2012; Di Maio et al., 2017; Ellen MacArthur Foundation, 2016; Lewandowski, 2016; Lieder & Rashid, 2016). Recent research has shown that different factors influence circular business model innovation (CBMI), such as government policies and international institutions pushing for transformational change (Centobelli et al., 2020), and multi-stakeholder, cross-sectoral collaborations (Kanda et al., 2021; Suchek et al., 2021; Zucchella & Previtali, 2019).

While the existing literature has explored enablers and barriers influencing CBMI at macro-, meso-, and organizational levels, less attention has been paid to the role of micro-, individual level factors (Sawe et al., 2021), such as individuals' cognitive frames. Furthermore, better understanding of cognitive frames at the micro-level can help explain problems occurring at other levels in terms of communication and collaboration for sustainability (Preuss et al., 2023). CBMI is a

Abbreviations: CBM, circular business model; CBMI, circular business model innovation; GHG, emissions greenhouse gas emissions; R & D, research and development.

complex process that requires multi-stakeholder collaboration, and it is not yet fully understood how individuals involved in collaborative projects for CBMI conceptualize new circular business models (CBMs), which is an important pre-step to the development of CBMs in practice. We therefore argue that there is a need for more empirical research on the role of individuals' cognitive frames for CBMI. To address this gap, we explore the following research question: *How do individual stakeholders' cognitive frames of sustainability influence the conceptualization of new CBMs?*

To answer our research question, we conducted an exploratory study by applying a mixed methods approach on a multi-stakeholder project *Alpha*[1], which involved CBMI for resource recovery from agricultural and food processing waste (bio-based industry). First, we used a cognitive mapping technique to investigate how individuals conceive of different sustainability issues of interest and the relationships between those sustainability issues. Second, we observed individuals in a group situation at the multi-stakeholder workshop where they collectively created and adjusted their cognitive frames to design new CBMs. Our assumption was that individual stakeholders' cognitive frames of sustainability would influence their conceptualization of new CBMs, namely, the main building blocks in developed CBMs, such as value-added propositions.

Findings of this exploratory study suggest that cognitive frames are of primary importance in sensemaking of CBMs. Our empirical data complement previous research on drivers and barriers influencing CBMI (Geissdoerfer et al., 2023; Guldmann & Huulgaard, 2020; Hina et al., 2022; Tura et al., 2019) and the role of cognitive frames for sustainability (Bergman et al., 2016; Bianchi & Testa, 2022; Carmine & De Marchi, 2022; Hoppmann et al., 2023; Preuss et al., 2023). The study identifies links between individual stakeholders' cognitive frames and conceptualized CBMs that were developed for the *Alpha* project. While further research is needed to build a solid evidence base, our research indicates that cognitive frames of individuals involved in multi-stakeholder collaboration for CBMI can influence design and consequently implementation of CBMs in practice.

The paper proceeds as follows: In Section 2, the literature review, we show how cognitive frames are the missing micro that is relevant for CBMI. In Section 3, we discuss research methods used in our study. Section 4 provides data analysis, which is followed by discussion in Section 5. By way of conclusion, in Section 6, we discuss how the paper contributes to theory and practice on CBMI with implications for business strategy more broadly and offers future research avenues.

2 | LITERATURE REVIEW

This literature review brings together two fields: the literature on cognitive frames for sustainability and the literature on the CBMs to address the missing micro in the context of CBMI. It shows that cognitive frames have been applied to sustainability more broadly but not specifically to the CBMI context, giving rise to our assertion that cognitive frames constitute a missing micro-level analysis and pre-step to how individuals make sense of and conceptualize CBMI.

2.1 | Cognitive frames: The missing micro

The idea that people develop and use cognitive frames as internal representations of external reality has been widely accepted for several decades in cognitive science and psychology literature (Jones et al., 2011). In organization theory, cognitive frames are understood as mental representations that enable managers and organizations to orientate themselves for action in a complex environment inside and outside organizations (Hielscher & Will, 2014). Cognitive frames are thinking frameworks that individuals use to make sense of different information and relationships among them (Beach & Connolly, 2005; Porac & Thomas, 2002), and they direct actions and influence the scope of possible solutions when dealing with identified issues (Barr et al., 1992). Furthermore, cognitive frames can be used to measure individuals' and groups' knowledge of a specific domain and to communicate how individuals and groups think about that domain (Wood et al., 2012).

Finkelstein and Hambrick (1996) have explored managerial cognition and proposed cognitive frames with three elements: cognitive content, cognitive structure, and cognitive style. The cognitive content represents beliefs, knowledge, and assumptions of decision-makers. The cognitive structure shows how decision-makers arrange, connect, and study cognitive content in their mind, while cognitive style refers to the collection and processing of new information. These three elements are interconnected and influence how decision-makers frame strategic problems and plan strategic choices. To elicit and explore individuals' internal cognitive frames, researchers have been using different cognitive mapping techniques. The outputs of such techniques are cognitive maps, that is, reconstructions of subjective beliefs that individuals reveal to researchers (Eden et al., 1992). Cognitive maps are research artifacts that show how individuals perceive relationships between different concepts (e.g., causal relationships) (Swan, 1995).

2.2 | Cognitive frames and sustainability

Organizations and businesses face diverse sustainability issues of economic welfare, social prosperity, and environmental protection that are connected and interdependent (Bansal, 2002; Maon et al., 2008). Understanding complex sustainability issues and their connections can be challenging for decision-makers, which can affect corporate sustainability and organizational identity (Cherrier et al., 2012) and priority areas (Bertels et al., 2016). As Wade and Griffiths (2022) suggest, the lack of organizational action needs to be addressed by examining the cognitive foundations of managerial decisions on sustainability. Therefore, cognitive theories of knowledge representation, such as cognitive frames can be applied to explore individuals' (managers, leaders, stakeholders) understanding of sustainability issues and interconnections between them to design transformative strategies and actions for sustainability.

Individuals' cognitive frames of sustainability can vary in their complexity and focus on different dimensions of sustainability. Hahn et al. (2014) conceptualized two contrasting types of cognitive frames that can be used to understand business decision-making in the context of sustainability: the business case frame (focusing on social and environmental issues that align with economic objectives) and the paradoxical frame (considering interrelationships and contradictions between social, environmental, and economic issues). Building on Hahn et al.'s (2014) work, Preuss and Fearne (2022) theorized the structure of cognitive frames of supply chain managers and proposed a typology of cognitive frames relevant to sustainable supply chain management. The authors discussed the impact of proposed cognitive frames on decision-making for sustainable supply initiatives, environmental/social consequences, and the level of innovative solutions. Cognitive diversity and interaction between different cognitive frames were also observed in practice. For example, Sharma and Jaiswal (2018) explored how cognitive frames of individuals interact across different organizational levels to manage sustainability tensions in the context of the bottom of the pyramid projects. Other findings from early empirical studies on cognitive frames for sustainability also showed that managers from top sustainability performing companies held more complex cognitive frames (in line with the assumptions of a paradoxical frame) compared to the managers from the companies with a lower sustainability performance (Hockerts, 2015). Bergman et al.'s (2016) study, which also focused on the structure and content of cognitive frames of sustainability, found that in cleantech sector managers prioritized economic issues, meaning sustainability was pursued to achieve more traditional corporate objectives, rather than being a goal in itself (business case frame).

More recent empirical studies explored cognitive frames and their relationship with other variables at individual and collective level for organizational change for sustainability. There is evidence that interaction between sense giving, role identities, and cognitive frames influence organizational change (Hoppmann et al., 2023). Similarly, Bianchi and Testa (2022) investigated relationships between different processes suggesting that cognitive frames have an impact on decisions about life cycle management and organizational learning processes. Benkert (2021) focused on investigating the role of managers' values and logics that affect their cognitive frames. The study showed that stronger sustainability values were linked to more holistic cognitive frames (consideration of different sustainability tensions). Empirical research on paradoxical tensions also showed that collective, organizational cognitive frames of sustainability lead to higher social and environmental outcomes (Carmine & De Marchi, 2022) and have a positive effect on the development of organizational capabilities, such as stakeholder integration, market sensing, and organizational learning (Grewatsch & Kleindienst, 2018).

The seminal work on cognitive frames of sustainability by Hahn et al. (2014) motivated new theoretical and empirical research in business and management that focused on different contexts and levels of analysis. Despite these valuable contributions in the areas of organizational change and strategic decision-making for sustainability, we currently lack understanding of how cognitive frames influence conceptualization of new business models for sustainability, such as CBMs, which is an important pre-step for the development of CBMs in practice to achieve transition toward circular economy and enable sustainable development.

2.3 | Link with CBMI

The dominant, linear economic system based on the *take*, *make*, *dispose* approach has led to overexploitation of natural resources with negative environmental and social consequences. Therefore, our societies need to adopt more sustainable production and consumption methods to ensure the future provision of natural resources, such as food and clean air (Lampert, 2019). The circular economy is an alternative way forward that eliminates waste and pollution through restorative and regenerative design and circulation of resources at their highest utility and value in technical and biological cycles (Ellen MacArthur Foundation, 2016). To enable increased circularity of resource flows, durability, reusability, and recyclability should be designed into products and processes, while also considering technological/processing capabilities, waste collection practices, and consumer behavior (Velenturf & Purnell, 2017). The circular economy treats waste as a valuable resource from which value can be captured. Broadly, there are four distinct types of waste: (1) wasted resources (cannot be effectively regenerated); (2) wasted capacity (underutilized products and assets); (3) wasted life cycles (due to unsustainable design); and (4) wasted embedded value (resources not recovered from waste streams) (Lacy & Rutqvist, 2015). The transition toward circular economy requires new business models that challenge the linear logic of value creation (De Angelis et al., 2023) and that require an ecosystem of multiple stakeholders for cross-sectoral collaboration (Kanda et al., 2021; Suchek et al., 2021).

CBMs promote economic, environmental, and/or social goals; include multi-stakeholder collaboration; focus on the long-term perspective; and can close, slow, intensify, narrow, or dematerialize resource loops (Bocken et al., 2016; Geissdoerfer et al., 2018). In recent years, five CBMs (circular inputs, sharing platforms, product as a service, product use extension, and resource recovery) have been accepted across industries as a viable approach to implement circular economy strategies (Lacy et al., 2020). Resource recovery has been most widely adopted in practice as it is an extension of traditional waste management, and thus less disruptive to existing business structures compared to other CBMs. However, there are barriers that stifle a more rapid adoption and scalability of this CBM, such as high costs of waste collection and separation, and limited infrastructure to ensure quantity and quality of recovered resources. But, as Lacy et al. (2020) suggest, technological advances, resource shortages, and regulatory changes, such as extended producer responsibility, and consumer pressure will help drive wider adoption of resource recovery across industrial sectors.

Recent research has focused on exploring different factors influencing CBMI. For example, Centobelli et al. (2020) suggested that CBMI requires implementation of managerial practices for value creation, value delivery, and value capture. The practical implementation of CBMs also requires continuous progress control, such as the achievement of circular economy targets. Factors at the macro-level, such as policies and international institutions pushing for transformational change of existing production processes and consumption patterns, and emerging technologies must also be considered. Another research topic that has attracted attention is stakeholders' interaction and cross-sectoral collaboration (Kanda et al., 2021; Suchek et al., 2021; Zucchella & Previtali, 2019). Multi-stakeholder collaboration plays an important role not just during the CBMI but also during implementation and operation phase (Sousa-Zomer et al., 2018). Other researchers have focused on the interplay of different drivers and barriers influencing CBMI (Guldmann & Huulgaard, 2020; Hina et al., 2022; Tura et al., 2019), and more recently (Geissdoerfer et al., 2023) explored how different drivers and barriers affect four generic CBMI types: start-up, diversification, transformation, and acquisition.

While drivers and barriers at macro- and meso-level and organizational level have received vast attention in the CBM literature, there is a lack of research when it comes to micro-level, individual factors (Sawe et al., 2021). Considering the importance of cognitive frames lies in their implications for decision-making that determines the future strategic choices and actions (Finkelstein et al., 2009), it is necessary to better understand the role of cognitive frames and how they influence design, innovation, and implementation of new CBMs. In our study, we were particularly interested in establishing a connection between cognitive frames and conceptualization of new CBMs as revealed in the multi-stakeholder project *Alpha*.

3 | METHODOLOGY

This study aimed to investigate how individual stakeholders' cognitive frames of sustainability influence CBMI by applying a mixed methods approach. Data were collected using quantitative and qualitative methods to gain a more complete understanding of how individuals involved in a multi-stakeholder collaboration perceive sustainability issues and how their cognitive frames of sustainability inform CBMI. The mixed methods approach comprised two stages: Stage 1 involved collection of data from online surveys and Stage 2 involved participant observations in a group situation during a CBMI workshop. In the following sections, we introduce the research context and outline each stage of data collection.

3.1 | Research context: Alpha project

The context for this study was a pilot project that aimed to develop the production of multiple, high-value products using crops and food processing residues, known as the *Alpha* project. The context was appropriate to investigate our research question because it involved multi-stakeholder collaboration to develop new CBMs. Stakeholders involved in the project came from 11 European countries and included agricultural and food processing businesses, agricultural cooperatives, waste management agencies, laboratories and research institutes, and end users. Our assumption was that individual stakeholder representatives' understanding of relationships between sustainability issues could affect the conceptualization of new CBMs and consequently their development in practice.

The main objective of the *Alpha* project was to build two pilot biorefinery plants to demonstrate technical and commercial feasibility for high-value compounds extraction such as proteins and phenolic acids from crops and food processing residues. The agricultural and food industry would provide residues from processing four types of crops: tomatoes, potatoes, olives, and cereals, and an online platform would serve as an interface for stakeholders to contribute their residues as feed stocks for biorefinery plants. The biorefineries would provide a range of processing technologies for the extraction of compounds to produce a cascade of bio-based products such as food additives and ingredients, materials for agriculture, bio-fertilizers, biopackaging, biochemicals, and additives including fibers and biogas. During this study, the *Alpha* project was in the final stages of testing phase for extraction processes and technologies.

3.2 | Mixed methods study investigating cognitive maps within the Alpha project

The study, which provides the focus for this paper, investigated the cognitive mapping process of individuals who participated in a multistakeholder workshop in the *Alpha* project. We focused on the early stages of conceptualizing CBMs and how individuals thought about sustainability issues and their connections prior to participating in the multi-stakeholder workshop on CBMI. We looked at two stages of cognitive mapping process:

Stage 1: Pre-workshop. In this stage, we investigated how individuals conceive of different sustainability issues of interest and relationships between those sustainability issues.

Stage 2: During workshop. In this stage, we observed individuals in a group situation at the multi-stakeholder workshop where they designed CBMs.

We argue that understanding how individuals create their cognitive frames at early stages of CBMI is an important pre-step for the development of CBMs in practice.

In Stage 1, 14 participants responded to an online survey about sustainability issues related to the bio-based industry and perceived relationships between them. The purpose of the survey was threefold: (1) to explore perceptions about the importance of sustainability issues among individual stakeholders in the *Alpha* project; (2) to identify the most central sustainability issues for the stakeholders; and (3) to explore how they perceive relationships between sustainability issues. The survey method was chosen because it enabled us to reach individual stakeholders from different European countries and because it was effectively used in previous studies across different disciplines to elicit cognitive maps (e.g., Brown, 1992; Jetter & Kok, 2014). The survey was distributed to the *Alpha* project network via email and was available in English and Spanish. Translation and editing were done by two native Spanish speakers to ensure appropriate Spanish equivalents to English terms. Participants came from a range of industrial sectors including food processing (four participants), agricultural (two), waste management (one), packaging (one), consulting (one), and R&D (five). The average age of stakeholders was 42.5 years, and they held different job roles including CEO, technological group manager, and project manager. Most stakeholders (71%) had more than 6 years at their respective organizations, and 57% were educated to PhD level. Respondents were Spanish (50%), Italian (36%), and German (14%). A survey was developed by reviewing literature to identify the most frequently mentioned sustainability issues in the bio-based industry. A list was derived grouping those issues into three categories: economic, environmental, and social (see Table 1). We then sought expert's opinion for completeness of the list. In total, 28 sustainability issues were selected based on the relevance criteria for bio-based industry within EU context, that is, consideration in the bio-economy strategy for Europe. We also considered the time constraints of participants, possible response fatigue, and selection difficulties if the list was too long (Markóczy & Goldberg, 1995).

The survey included three sets of questions. The first set aimed to identify the perceived importance of sustainability issues, and the second set aimed to identify the perceived relationships between the most important issues across three sustainability categories. For the second set of questions, the linking logic function of the survey was used to create different combinations of pairs depending on which issues were selected as the two priority issues in each sustainability category. In total, 15 different combinations of pairs were created for respondents to consider the relationships between them (positive, negative, or none) and strength of those relationships (weak, moderate, strong, or very strong). Finally, there was a set of demographic questions. Following a pilot test, the survey was released to the target participants via the workshop organizer.

TABLE 1 List of sustainability issues in the survey.

Economic	Environmental	Social
• Innovation, R&D[a]	• Water use	• Health and well-being
• New production processes	• Ecosystem services	• Employment
• Technological development	• Recycling	• Product/ service safety
• Innovative bio-based products	• Biodiversity loss	• Wages and benefits
• Food prices	• Land use	• Training and education
• Demand for bio-based products	• Greenhouse gas emissions	• Rural development
• Revenue	• Waste	• Working conditions
• Profit	• Energy use	• Ethical behavior and human rights
• Collaboration within supply chain, across industry sectors	• Pollution	
• Competitiveness	• Use of natural resources (biomass)	

[a]Research and development.

The identified relationships between sustainability issues in the survey and their strength (0, *No relationship*; 0.25, *Weak relationship*; 0.5,*Moderate relationship*; 0.75,*Strong relationship*; and 1,*Very strong relationship*) were then inputted into the Mental Modeler software (Gray et al., 2014b) to visualize and analyze elicited cognitive maps. The Mental Modeler software was validated in previous research; for instance, it was used to explore differences between stakeholders' beliefs in the context of conservation agriculture (Halbrendt et al., 2014); to assess stakeholders' perceptions of climate vulnerability (Gray et al., 2014a); to investigate the integration of stakeholders' knowledge into the governance of socio-ecological systems (Vasslides & Jensen, 2016); and to explore stakeholders' perceptions of factors influencing large-scale renewable energy projects (Konti & Damigos, 2018). Therefore, we considered this tool to be appropriate to use in our analysis of elicited cognitive maps.

Components of the cognitive maps were derived from the most important issues identified by respondents, two from each sustainability category (environmental, social, and economic). A cognitive map example is shown in Figure 1. Arrows represent relationships between sustainability issues as identified by respondents. The relationships' strength is represented with weights ranging from -1 to $+1$. Plus and minus signs indicate the type of relationship between sustainability issues, that is, positive and negative correlation. For instance, -1 between recycling and GHG emissions means that an increase in recycling leads to a very strong decrease in GHG emissions.

Sustainability issues that influence other issues in the cognitive map but are not influenced themselves by other issues are called driver sustainability issues. In contrast, receiver sustainability issues are those that are influenced by other issues in the cognitive map and themselves do not influence others. Ordinary sustainability issues can do both, influence other issues in the map, and be influenced by others. For instance, the cognitive map in Figure 1 has one driver sustainability issue (*Innovation, R&D*), one receiver sustainability issue (*Health and well-being*), and four ordinary sustainability issues (*Recycling*, *GHG emissions*, *Product/service safety*, and *Technological development*). The centrality score of an individual sustainability issue in the cognitive map shows the importance of that issue in the whole structure of the cognitive map (Özesmi & Özesmi, 2004). It is an absolute value obtained by adding all the relationships' (in-arrows and out-arrows) weights for that sustainability issue (Gray et al., 2013). For instance, the centrality score of *Innovation, R&D* is $1 + 1 + 1 + 0.5 + |-0.75| = 4.25$. The higher the centrality score, the greater the importance of that issue in the cognitive map. The *Health and well-being* issue achieved the lowest centrality score of 1.25, which was obtained by adding $0.5 + 0.75$. Table 2 shows the centrality score of sustainability issues for each cognitive map.

In Stage 2, the first author observed and interacted with participants at two multi-stakeholder events: a general assembly meeting and a CBMI workshop held in Spain. The general assembly meeting involved 55 representatives from the stakeholder groups involved in the *Alpha* project, and 73 representatives participated in 1-day CBMI workshop. Data were gathered through note taking during the meeting and workshop and the preparation of a reflective

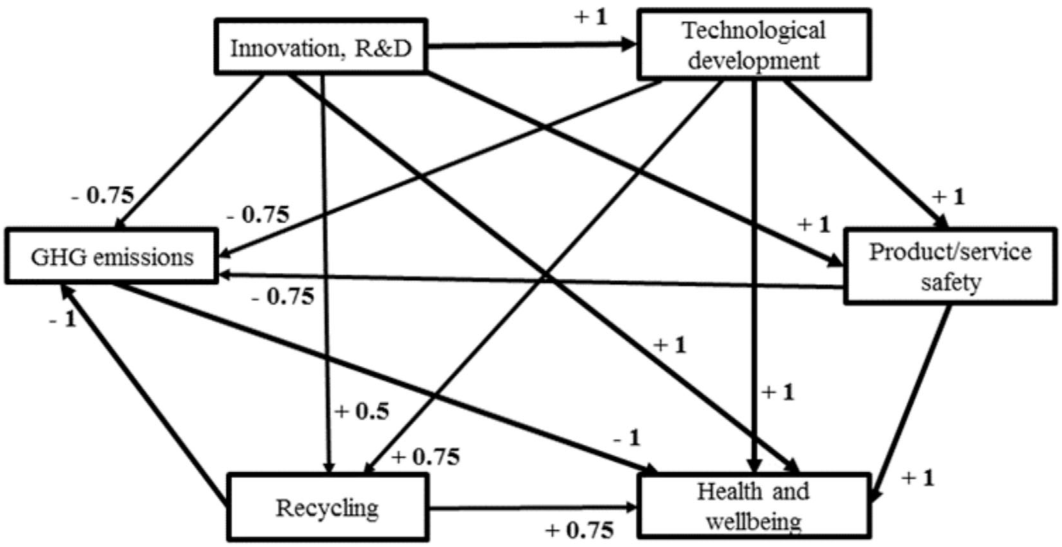

FIGURE 1 Cognitive map with six sustainability issues; in-arrows and out-arrows represent relationships and numbers represent weights (R&D: research and development, GHG: greenhouse gas emissions).

diary afterwards. During the workshop, a group of six stakeholders' representatives was observed. The first author, who observed the group, was assigned to this group by the workshop organizers. Participants included a quality manager from agricultural sector (PO1), an R&D manager from food processing industry (PO2), a representative from a waste management agency (PO3), a representative from a wine cooperative (PO4), a CEO from a cooperative (olive oil, dry/citrus fruits) (PO5), and a representative from a food supplements business (PO6). Documentary data at the project-level were collected from publicly available documents (website and project reports), as well CBMs developed during the workshop.

4 | RESULTS

Key results from Stage 1 show that economic issues were among the most central issues in 10 stakeholders' cognitive maps. Twelve cognitive maps had one driver sustainability issue and in seven cases that was *Innovation, R&D*. None of the cognitive maps included *Demand for the bio-based products*. Results from Stage 2 show links between sustainability issues in the cognitive maps and the elements in developed CBMs. For instance, *Innovation, R&D* was identified as one of the main activities and key value-added proposition in CBMs.

4.1 | Cognitive frames of sustainability issues

In Stage 1, *Pre-workshop*, we investigated how individuals conceive of different sustainability issues of interest and relationships between those sustainability issues. Previous research on content and structure of cognitive frames of sustainability has shown that business case cognitive frames are linked to traditional, profit-maximization-orientated business decision-making, while paradoxical cognitive frames are linked to stronger sustainability-focused decision-making. While Bergman et al. (2016) found long-term profitability as the most central sustainability issue in the cognitive frames of managers in the context of cleantech sector (sustainability as a vehicle to achieve traditional corporate objectives rather than a goal in itself), we found other economic sustainability issues to be more prominent, especially *Innovation, R&D*. *Innovation, R&D* is at the heart of *Alpha's* resource recovery model that requires new extraction methods, production processes, and product/service development to address the issue of food waste in the EU context. Also, innovation and new technologies are one of the key drivers (or barriers when lacking) for CBMs including resource recovery from waste (Lacy et al., 2020). Thus, it is not surprising that individual stakeholders prioritized innovation over other economic issues. Furthermore, individuals' cognitive frames are shaped by their experience and job roles. For participants with CoM1 and CoM14 cognitive map, *Innovation, R&D* has always been one of the key processes in their organization along with new product development and collaboration with partners to achieve competitive advantage and profitability.

A surprising finding is that none of the cognitive maps included demand for bio-based products. Provision of new, everyday eco-products is one of the main goals in the *Alpha* project; thus, we would expect that the demand side would be considered more important. Which leads to a question: Is the project developing the right products to address existing needs and tackle the food waste challenge? Our result suggests that *Alpha* network has been set up with a focus on developing CBMs without due consideration of its customers. Customer needs and their changing preferences can be an important driver or barrier for CBMs (Hina et al., 2022; Kirchherr et al., 2018). In terms of resource recovery, this is customers' perceptions of bio-based products (quality and safety concerns), willingness to switch to more sustainable alternatives and willingness to pay (Brunnhofer et al., 2020; Russo et al., 2019). Lacking understanding and

TABLE 2 Centrality scores of sustainability issues in the elicited cognitive maps.

Cognitive map	Most central sustainability issues	Type of sustainability issue and centrality score
CoM1[a]	Collaboration within supply chain, across industry sectors	Economic (2.75)
CoM2	Use of natural resources Innovation R&D[b]	Environmental (3.5) Economic (3.5)
CoM3	Innovation, R&D	Economic (4.25)
CoM4	Innovation, R&D Innovative bio-based products Use of natural resources	Economic (5) Economic (5) Environmental (5)
CoM5	Health and well-being	Social (2.5)
CoM6	Health and well-being Rural development Water use Biodiversity loss Innovation, R&D Competitiveness	Social (5) Social (5) Environmental (5) Environmental (5) Economic (5) Economic (5)
CoM7	Innovation, R&D	Economic (4.25)
CoM8	Technological development Innovation, R&D	Economic (3.75) Economic (3.75)
CoM9	Rural development	Social (4.75)
CoM10	Innovation, R&D Technological development Ecosystem services Employment (job generation)	Economic (4) Economic (4) Environmental (4) Social (4)
CoM11	Health and well-being	Social (4.75)
CoM12	Product/service safety Recycling	Social (4) Environmental (4)
CoM13	Innovation, R&D	Economic (2.75)
CoM14	Innovation, R&D	Economic (5)

[a]Cognitive map (stakeholder 1 to 14).
[b]Research and development.

consideration of customers' needs can lead to designing ineffective CBMs, which can have negative consequences for transition toward circular economy at the system-level.

4.2 | Linking cognitive maps of sustainability issues and developed CBMs

In Stage 2 *During workshop*, we observed individuals in a group situation at the multi-stakeholder workshop for CBMI. We expected participants to apply their cognitive frames of sustainability issues to design new CBMs; hence, sustainability issues in the elicited cognitive maps should be reflected in CBMs. Economic issues that achieved high centrality scores in cognitive maps: *Innovation, R&D*, *Technological development*, and *Collaboration within supply chain, across industrial sectors* have clear links to different building blocks for value creation, value delivery and value capture in the developed CBMs (see Table 3). *Alpha* was an early-stage "upstream," technology-focused, multi-stakeholder initiative; thus, it is not surprising to see central economic, sustainability issues from cognitive framing translated to CBMs. In terms of environmental issues, different aspects of *Use of natural resources (biomass)*, such as quality and storage of biomass, were identified across different building blocks in each individual CBM (activities, value-added propositions and key partnerships). Agricultural and food processing waste biomass is a resource for high-value chemicals and effective storage is necessary to ensure physical–chemical characteristics are preserved, and quality is not compromised (Degueurce et al., 2020; Fisgativa et al., 2016). The purpose of resource recovery from agricultural and food processing waste is to extract compounds such as proteins and antioxidants for high-value applications in food, chemical, and other industries (Khiari, 2017); thus, it is not surprising to see central environmental issues from cognitive framing translated to CBMs. Links between cognitive frames of sustainability and decision-making/action-taking, as well as sustainability performance outcomes at organizational level, have been observed in existing literature (Bergman et al., 2016; Bianchi & Testa, 2022; Hockerts, 2015; Hoppmann et al., 2023) and our findings complement that literature within the context of CBMI.

However, social issues were less likely to be included in the CBMs even though they were quite central in the cognitive maps. For instance, CBM3 and CBM4 (see Table 3) addressed *Products/service safety* either as a type of benefit for the business or value-added proposition. CBM1 included an aspect of *Rural development* as costs and benefits created and shared in the wider circular supply chain. No links were found between *Health and well-being* and CBMs. We expected to see aspects of *Product/service safety* to be more prominent across CBMs because of the legal challenges associated with the production of bio-based products for human consumption and consumers' negative perceptions of products derived from agricultural and food processing waste (Aschemann-Witzel & Stangherlin, 2021; Sousa et al., 2021). The missing links between social issues and CBMs have been addressed in the wider context of circular economy. For example, Murray et al. (2017) critiqued the circular economy approach for not recognizing social aspects of human rights, equity, and well-being that are otherwise central to the concepts of sustainability and sustainable development. Furthermore, research on CBMs has emphasized the need of including and measuring social performance (Lee et al., 2012) as well as environmental performance (Bakker et al., 2014) to achieve sustainability. The mismatch we found between the centrality of social issues in the cognitive maps and the building blocks of CBMs indicates that *Alpha* project might not deliver high social performance, even though stakeholders prioritize social issues.

The group observation (PO1–6) also revealed difficulties articulating CBM elements, which has been contributed to the level of previous experience with circular economy concept and other sustainability-related concepts, such as CSR. Furthermore, participants commented on different ways of thinking/existing mindsets among stakeholders (e.g., cooperatives vs. other businesses) in relation to circular economy, which can be mediating factors affecting design of CBMs.

TABLE 3 Links between central sustainability issues in the individual stakeholders' cognitive maps and circular business models.

Sustainability issues with the highest centrality scores in cognitive maps	CBM1[a]	CBM2[b]	CBM3[c]	CBM4[d]
Innovation, R&D[e]	**Activities**	**Activities**	Activities Value-added proposition	**Value-added proposition**
Technological development	• Value-added proposition • Key partnerships • Costs	• Value-added proposition • Key partnerships • Activities • Benefits • Customer relationships • Customer segments	• Value-added proposition • Customer relationships • Channels	• Assets
Collaboration within supply chain, across industrial sectors	• Key partnerships • Customer relationships	• Key partnerships • Value-added proposition • Customer relationships	• Key partnerships • Value-added proposition • Customer relationships	• Key partnerships • Customer relationships
Health and well-being	• Not identified	• Not identified	• Not identified	• Not identified
Rural development	• Costs and benefits created and shared in the wider circular supply chain	• Not identified	• Not identified	• Not identified
Product/service safety	• Not identified	• Not identified	• Benefit	• Value-added proposition
Use of natural resources (biomass)	• Activities • Value-added proposition • Key partnerships	• Activities • Value-added proposition • Key partnerships	• Activities • Value-added proposition • Assets • Benefits	• Key partnerships • Benefits

Abbreviation: CBM, circular business models.
[a]Circular business model: cooperative for olive and potato waste.
[b]Circular business model: cooperative for tomato and cereal waste.
[c]Circular business model: biorefinery for olive and potato waste.
[d]Circular business model: biorefinery for tomato and cereal waste.
[e]Research and development.

5 | DISCUSSION

The results of this study suggest that individual stakeholders' cognitive frames of sustainability influenced the conceptualization of CBMs (resource recovery from waste), that is, aspects of different sustainability issues were included in the resulting CBMs. Specifically, links between central sustainability issues in the cognitive maps and building blocks in the CBMs were identified. For instance, aspects of *Innovation, R&D* were identified in the *Activities* and *Value-added proposition* building blocks in the CBMs (see Table 3). However, the centrality of sustainability issues alone might not be the most important factor in CBMI. For example, *Health and well-being* and *Rural development* were both central sustainability issues, but only one link associated to *Rural development* was found in CBM1. No links were identified between *Health and well-being* and CBMs. Therefore, it can be inferred that interplay of centrality and type of sustainability issue play a more important role in the development of CBMs than centrality alone. It is important to emphasize that relationships between sustainability issues in the cognitive maps and building blocks in the CBMs make no assumptions about causality due to the type of cross-sectional data. The aspects related to economic and environmental issues were more likely to be identified across different building blocks in the CBMs than social aspects. These findings suggest that even though stakeholders considered relationships between different sustainability issues in their cognitive maps, there was a tendency to prioritize aspects of economic and environmental issues in the CBMs. Therefore, they might have overlooked some opportunities for creation and delivery of broader societal benefits when thinking about CBMs.

Previous research has used cognitive frames to explore stakeholders' perceptions and motives in relation to sustainability. Competitive advantage has been identified as the main driver for businesses to engage with sustainability activities (Hockerts, 2015). Bergman et al. (2016) found that long-term profitability was the most central sustainability issue in the cognitive frames of decision-makers in the case companies in the cleantech sector. Similarly, in the agricultural context, economic viability of the farm was identified as the most influential issue in the cognitive frames (Hoffman et al., 2014). Yet, financial indicators such as profit and revenue were not the most central issues in the individual stakeholders' cognitive maps in the current study. Rather, it was innovation, technological development, and collaboration. Furthermore, the centrality of social issues was also noticeable, which differs from previous findings.

The CBMI enables organizations to integrate circular economy principles through creation of new CBMs. The *Alpha* project was trying to achieve this by building CBMs that create value from agricultural and food processing waste. The findings of the current study suggest that individual stakeholders' cognitive frames of sustainability issues influence what aspects of economic, environmental, and social issues are considered and included in the building blocks of the new CBMs. These decisions can affect the level of circularity and sustainability performance achieved in practice. CBMs developed for the *Alpha* project tackle the problem of agricultural and food processing waste by collaborative approach. Individual stakeholders involved in the project exchange knowledge, information, expertise, and technology to improve address the issue of food waste and create broader societal benefits. However, stakeholders' perceptions of sustainability issues that underpin their cognitive frames might limit the scope of identified opportunities for sustainability benefits if important drivers such as consumer demand are not being considered. The project leaders should consider addressing this issue before scaling up the project to the industrial level.

6 | CONCLUSION

We argued at the beginning of this article that there is a need for more empirical research on the role of individuals' cognitive frames, especially in the circumstances when individuals are making sense of new concepts, such as circularity and CBMs. Our research indicates that cognitive frames of individuals involved in multi-stakeholder collaboration for CBMI can influence design and consequently implementation of CBMs in practice. Therefore, deeper understanding of cognitive frames at the micro-level can help prevent problems occurring at meso- and macro-levels in terms of communication and multi-stakeholder collaboration for circular economy and sustainability more broadly, which is in line with Preuss et al.'s (2023) work. Our work also complements previous research on factors influencing CBMI (Kanda et al., 2021; Suchek et al., 2021; Zucchella & Previtali, 2019), by addressing the role of the missing micro.

Findings from the study contribute to the debate about business model innovation for sustainability more broadly and specifically to CBMI by furthering understanding of the influences of cognitive frames. Empirical analysis of stakeholders' cognitive maps of sustainability found links between perceived important sustainability issues and developed CBMs. This suggests that cognitive frames influence decision-making about what aspects of economic, environmental, and social issues, and what scope will be included in the building blocks of the CBMs. This study contributes to the literature that applied cognitive perspective to sustainability (Bergman et al., 2016; Bianchi & Testa, 2022; Carmine & De Marchi, 2022; Hoppmann et al., 2023; Preuss et al., 2023) and complements previous research on drivers and barriers influencing CBMI (Geissdoerfer et al., 2023; Guldmann & Huulgaard, 2020; Hina et al., 2022; Tura et al., 2019).

Our findings contribute to the CBMI in the particular context of closing loops in agricultural and food processing waste by introducing attention to the cognitive framings, which influence how individuals address the problem of circularity. The article, with its introduction of micro-level cognitive framing, contributes to understanding of how a priori cognitive frames of sustainability are brought into the CBMI informed by a priori experience. We have also gleaned through the article an insight and possible explanation (to be verified in other circular/technological settings) of how micro-level (individual) cognitive frames contribute to possible technological innovation and R&D pathways lock-in. This also points to a policy recommendation to ensure that reflections from a wider constituency of societal actors (e.g., civil society and NGOs) might supplement this *Innovation, R&D* framing within the CBMI workshop. We recommend inclusion of cognitive frames from societal actors and how they translate them into CBMs to sit alongside the Innovation and R&D framings of the businesses, in order to broaden and stimulate the involvement and uptake of the wider ecosystem of actors to ensure that in the move from cognitive frames to CBMI wider societal considerations and social issues do not get lost or left out in the broader mission-driven innovation systems trajectory.

The findings can also help business decision-makers to understand the importance of cognitive frames for enhancing circular strategies (from idea to action). As Blomsma et al. (2023) suggested, management and organizational practitioners as well as academics require a better understanding of relationships between different circular strategies to contribute toward accelerated implementation of circular economy in businesses. Communication and shared understanding of new concepts, such as circularity and CBMs, among business decision-makers are crucial for successful business strategy formation and execution, and they need visualization support at different stages of the process (de Salas & Huxley, 2014; Platts & Hua Tan, 2004). We argue that uncovering individual's cognitive frames and playing these back to multi-stakeholder groups can be used as a reflexive management tool to facilitate collective circular strategy visualization and support strategic foresighting, including which aspects of sustainability and circularity are absented in the cognitive frames and potentially feeding these into revised visualizations and strategic foresighting activities. It can thus also help management and organizational practitioners to identify similarities/differences in their understandings of circularity (e.g., advantages and disadvantages of different circularity approaches, synergies between CBMs, scope of potential impacts) to create enlightened business strategies, which simultaneously combine commercial profitability, improvements to the natural environment, and positive social impact. Using cognitive framing in a structured and systematic way can help practitioners in their strategic thinking about implementation of circular economy for sustainable futures and to anticipate and prepare for changes. As suggested by Bansal et al. (2024), business strategy can no longer ignore planetary boundaries and should consider and account for opportunities through regeneration (one of the key circular economy principles). More generally, as Finkelstein et al. (2009) pointed out, the importance of cognitive frames lies in their implications for decision-making, influencing the future strategic choices and actions of businesses.

The results of this study should also be considered in terms of its implications for further research. The empirical analysis, which linked cognitive maps and CBMs, focused on one case of CBMI in a multi-stakeholder collaboration. Additional cases would enable us to compare findings to further evaluate the strength of the linkages between cognitive frames of sustainability and CBMI. The results are also bounded to a specific point in time and stage in the *Alpha* project. Cognitive frames are considered to be dynamic structures that can change (Jones et al., 2011); thus, elicitation of cognitive maps during different stages of the project would enable us to observe potential changes to cognitive framings throughout the project and if those changes led to adjustments in CBMs. Consideration of context in research is important because it influences the occurrence and meaning of behavior at different levels (individual, organizational) (Johns, 2006). In this study, cognitive maps were elicited through a survey for individual stakeholders and their thinking about important sustainability issues happened in isolation. On the other hand, CBMs were built in a collaborative context where stakeholders with strong orientation toward social issues might have not put their ideas forward or were dismissed as less important by other stakeholders in the group.

Finally, while scholars have made important theoretical and empirical contributions about the role of cognitive frames for sustainability more broadly, more studies are needed to further develop the theory and build a stronger empirical base specifically in the area of CBMIs. We would encourage multiple-case studies focusing on multi-stakeholder collaboration, circular economy ecosystems across resource-based industries with significant environmental and social impacts, such as construction. Furthermore, we would encourage longitudinal studies focusing on investigating changes in cognitive frames of sustainability or cognitive frames of circularity over time in relation to CBMI. Cognitive mapping could also be combined with other research methods, such as reflective journals so that participants have space to critically reflect on their learnings about circular economy and how that influences their understanding and decision-making for CBMI.

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