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Managing Capabilities for Achieving Net Zero via a Circular Economy: A Multilevel Framework

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Corporate management faces increasing pressure to achieve both net-zero and circular economy (CE) goals. As organizations rarely manage this alone, they must develop novel capabilities within themselves and across their value chains and ecosystems. To explore capability development for achieveing net zero via circularity, we adopt a multilevel approach to capabilities theory. We explore an emerging innovation ecosystem and its two key value chains by interviewing 12 organizations pursuing carbon circulation in Finland. The findings are conceptualized into a framework that highlights the need for novel multilevel capabilities to achieve net zero via circularity (i) at organizational level, to improve operations, logistics, and risk management and anticipate policy development; (ii) at value-chain level, to manage risks, sustainability, synergy exploitation and new business logic; and (iii) at ecosystem level, for systemic knowledge development, system optimization, institutional co-creation and regionality. Managing capability development from organizational to value-chain level involves orchestrated or dispersed knowledge-sharing and value chain design, while at the ecosystem level, it requires a hybrid of these approaches involving knowledge-sharing, collaborative sensemaking and institutional co-creation. The findings advance management science and practice with insights into the diversity, allocation and foundational role of organizational-level capabilities in developing chain- and ecosystem-level capabilities.

Introduction

Corporate management across industries is increasingly concerned with climate change mitigation. Therefore, companies are looking to develop capabilities to decrease their carbon dioxide emissions and reach net-zero goals (European Commission, 2022; Sairanen and Aarikka-Stenroos, 2024), namely, the point at which organizational contributions to global warming stop (Bouckaert *et al.*, 2021; United Nations, 2015). To reach net zero, up to 45% of global emissions can be tackled through resource efficiency, waste reduction, material and energy savings, and circulation (Ellen MacArthur Foundation, 2019), in other words, by implementing the circular economy (CE) (Hailemariam and Erdiaw-Kwasie, 2023). However, from corporate management's perspective, pursuing the CE often requires changes in multiple levels of management, ranging from organizations' own operations (Kaipainen and Aarikka-Stenroos, 2022) to the value and supply chains (Farooque *et al.*, 2019) and the ecosystems to which they belong (Konietzko, Bocken and Hultink, 2020). Therefore, our objective is to explore capabilities and their development not only in individual organizations, but throughout their value chains and ecosystems, to reach the systemic sustainability goal of net zero via circularity.

In management science, capabilities represent the transformative ability of organizations to combine resources to reach a certain goal (Amit and Schoemaker, 1993; Dutta, Narasimhan and Rajiv, 2005), in our case, achieving net-zero targets via circularity. Following prior literature on sustainability-related capabilities (Demirel and Kesidou, 2019; de Arroyabe

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et al., 2021), pursuing net zero assumingly requires the capabilities to innovate (Arranz *et al.*, 2022; Santa-Maria, Vermeulen and Baumgartner, 2021), reconfigure internal and external competencies (Ambrosini, Bowman and Collier, 2009; Easterby-Smith, Lyles and Peteraf, 2009) and make strategic environmental decisions (Bocken and Geradts, 2020), for example, regarding pollution prevention, sustainable development and natural resource use (see also the Natural Resource-Based View; Hart, 1995). However, both the management literature and practitioners lack insights into the capabilities that address the systemic sustainability goals of net zero via circularity, including how to manage the development of such capabilities (Easterby-Smith, Lyles and Peteraf, 2009; Ethiraj *et al.*, 2005; Salvato and Vassolo, 2018).

Reaching sustainability goals such as net zero via circularity demands systemic changes (Geels, 2018) through joint efforts and collective action by multiple organizations (Akinci and Sadler-Smith, 2019; Fehrer and Wieland, 2021; Patala, Albareda and Halme, 2022). Therefore, we consider these systemic sustainability goals. The implication for management is the rise of the multilevel approach (Dagnino, Levanti and Mocciaro Li Destri, 2016; Kozlowski and Klein, 2000): organizations must manage not only their internal processes at the *organizational level* but also their collaboration in circular value chains (Aarikka-Stenroos *et al.*, 2022; Farooque *et al.*, 2019) and ecosystems (Konietzko, Bocken and Hultink, 2020). The *value-chain level* refers to the direct relationships among organizations that contribute to creating and delivering a product or service (Porter, 1980), which, in our study, leverage various capabilities to promote circularity and net zero. The *ecosystem level* refers to a broader community of hierarchically independent, yet interdependent, heterogeneous organizations, including for example value chain partners, regulatory authorities, standard-setting bodies, the judiciary, and educational and research institutions (Sahasranamam and Soundararajan, 2022) that interact with technologies and institutions to achieve a systemic goal (Korhonen, 2001; Thomas and Autio, 2020), such as a circular or low-carbon value proposition (Aarikka-Stenroos, Ritala and Thomas, 2021; Stokke *et al.*, 2022), presumably harnessing particular capabilities.

Acknowledging the need to manage systemic sustainability goals across organizational, value-chain and ecosystem levels, we aim to increase understanding in the management research of which capabilities can be leveraged at each level and how they can be developed across levels. Management research on capabilities has focused on organizational capabilities (e.g. Ambrosini, Bowman and Collier, 2009; Easterby-Smith, Lyles and Peteraf, 2009; McKelvie and Davidsson, 2009) and only recently acknowledged that entire value chains and ecosystems may collectively possess capabilities (e.g. Aslam *et al.*, 2018; Gupta, Panagiotopoulos and Bowen, 2023). Therefore, the literature falls short of explaining *what* capabilities are required at the value-chain and ecosystem levels or *how* they can be developed at these levels through complex mechanisms (see Gupta, Panagiotopoulos and Bowen, 2023; Kozlowski and Klein, 2000). This strikes as surprising, given that the persistent lack of multilevel collaboration for systemic sustainability goals increasingly concerns both management scholars and practitioners (George *et al.*, 2016; Patala, Albareda and Halme, 2022) and top management journals have long incorporated various corporate sustainability approaches (Meuer, Koelbel and Hoffmann, 2020; see, e.g., environmentalism, Shrivastava and Scott, 1992; and corporate sustainable development, Bansal, 2005).

To address the gaps in understanding the multilevel capabilities for net zero via circularity, we ask the following research questions: *RQ1: 'What capabilities need to be managed at the organizational, value-chain and ecosystem levels to achieve systemic sustainability goals?'* and *RQ2: 'How can the development of such capabilities be managed from the organizational level to the value-chain and ecosystem levels?'* To answer, we qualitatively explore an emerging innovation ecosystem that pursues net zero via circularity utilizing carbon circulation, which captures carbon emissions from industrial processes and closes the loop by circulating them into feedstock for new products (Chauvy and De Weireld, 2020; Naims, 2020). The analysed ecosystem circulates carbon via novel, partly pre-commercial processes for carbon capture and utilization in distinct value chains within a national carbon circulation innovation ecosystem.

Hereafter, we provide a theoretical overview of multilevel capabilities and their development for systemic sustainability goals at the organizational, value-chain and ecosystem levels. We then explain the case study design and the collection and analysis of data from an emerging innovation ecosystem and its two key value chains by interviewing 12 organizations pursuing carbon circulation in Finland. The findings, representing multilevel capabilities and how their development is managed across levels, are conceptualized into a framework and discussed. In the conclusion, we present our contributions to management science regarding multilevel capabilities and their development in ecosystems that address systemic sustainability goals. Finally, we discuss the limitations, future research avenues and implications for businesses and policymakers.

Theoretical background

Given the scarcity of net-zero capability research, we next synthesize prior management, sustainability, and CE studies on (i) capabilities at the organizational, value-chain and ecosystem levels; and (ii) how they

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can be developed across levels to address systemic sustainability goals such as net zero via circularity.

Capabilities for systemic sustainability goals at the organizational level

Management scholars have traditionally engaged in capabilities research at the organizational level, spanning the strategy, business and technology domains of a single organization (Ambrosini, Bowman and Collier, 2009; Easterby-Smith, Lyles and Peteraf, 2009). Typically, organizational capabilities have been explored to explain sources of competitive advantage (Ethiraj *et al.*, 2005) and enable companies to remain competitive in rapidly changing markets by adjusting their dynamic capabilities (McKelvie and Davidsson, 2009; Teece, 2007).

Organizational-level capabilities in this study refer to the ability of a single organization to combine its resources to address systemic sustainability goals, such as achieving net zero via circularity. Based on prior literature, we group them into strategic, market, innovation and sustainability management capabilities. *Strategic capabilities* include an organization's ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments by sensing opportunities and threats, seizing opportunities and transforming its resource base (known as dynamic capabilities; Teece, 2007), aligned with sustainability and CE principles (Bocken and Geradts, 2020; Santa-Maria, Vermeulen and Baumgartner, 2021). Strategic capabilities also appear in the literature as an organization's ability to acquire, assimilate, transform and exploit external knowledge for business opportunities (known as absorptive capacity; Marrucci *et al.*, 2022). Strategic capabilities seemingly link with *market capabilities*, which here involve understanding and responding to evolving customer demands for sustainable products in the markets and aligning product offerings with market trends favouring circular solutions (Khan, Daddi and Iraldo, 2020; Sairanen, Aarikka-Stenroos and Kaipainen, 2024). *Innovation capabilities* support the development of products, services and business models aligned with circular principles, thus aiming to capture value across the full product cycle (Saari *et al.*, 2024; Suchek *et al.*, 2021). *Sustainability management capabilities* refer mainly to the evaluation of the socio-environmental impacts of circular business (Scarpellini *et al.*, 2020) by introducing, for example, production indicators that align with the CE (Lopes de Sousa Jabbour *et al.*, 2019).

Capabilities for systemic sustainability goals at the value-chain level

Circular value and supply chains represent how companies and their direct up- and downstream organizations organize themselves to attain a circular flow of production and delivery, where materials and products maintain their value to the maximum extent instead of wasting them (Aarikka-Stenroos *et al.*, 2022; Farooque *et al.*, 2019). The value chain concept highlights value creation through direct organizational relationships (Porter, 1980), including value-added in traditional financial terms and the environmental value created through, for example, waste reduction, resource use optimization, and decarbonization (Sairanen, Aarikka-Stenroos and Kaipainen, 2024), compared to supply chain management that addresses the flow of materials and information (Harland, 1996).

Value chain capabilities here refer to value chains' ability to combine resources to address systemic sustainability goals. In management research, value chains are suggested to possess capabilities such as coordination, adaptability, agility, collaboration, integration and flexibility (Alzate *et al.*, 2022; Aslam *et al.*, 2018). Our literature review suggests that for value chains to transform into circular flows of resources, they must develop strategic, innovation, collaboration and resilience capabilities. At the value-chain level, *strategic capabilities* align with the definition of sustainable supply chain dynamic capabilities as their ability to deal with environmental change and internal complex relationships through value chain design capabilities, also called supply chain re-conceptualization (Beske, 2012). Strategic capabilities enable examination of the current chain configurations and external drivers; envisioning and innovatively exploring alternative configurations; navigating the implementation of the most effective configurations with the maximum number of stakeholders, and stabilizing the new circular configurations in the long term (Nacchiero, Massari and Giannoccaro, 2024). *Collaboration* and *innovation capabilities* enable the value chain to engage closely with new suppliers, customers and even competitors to co-develop and implement innovative circular solutions (Köhler, Sönnichsen and Beske-Jansen, 2022). Closely linked to the more general value-chain capabilities of agility, flexibility, efficiency and collaboration (e.g. Alzate *et al.*, 2022), the shift towards the CE requires also *resiliency capabilities* for value chains to proactively respond to market uncertainties, changing customer requirements and disruptive events (Chari *et al.*, 2022).

Capabilities for systemic sustainability goals at the ecosystem level

Reaching systemic sustainability goals often requires an understanding of value creation that goes beyond single companies and value chains to multi-organizational collaboration (Oskam, Bossink and de Man, 2021). The ecosystem-level view encompasses multiple interconnected value chains and industries in a heterogeneous multi-organizational setting of independent yet

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interdependent organizations, technologies and institutions pursuing a systemic goal (Korhonen, 2001; Thomas and Autio, 2020). We adopt the innovation ecosystem approach (see other conceptualizations, e.g., Aarikka-Stenroos and Ritala, 2017), which emphasizes innovation as the system level goal, and highlights related collaboration, interdependencies, co-evolution and the flow of value, materials, energy and information among organizations in the ecosystem (Aarikka-Stenroos, Ritala and Thomas, 2021; Sahasranamam and Soundararajan, 2022).

Ecosystem-level capabilities refer to how ecosystems can combine their resources to address systemic sustainability goals. Recent management research has proposed that ecosystems have capabilities such as resource fluidity and collective commitment (Sahasranamam and Soundararajan, 2022). However, CE studies have only implicitly addressed two major types of ecosystem-level capabilities: ecosystem collaboration and scalability. Capabilities related to ecosystem collaboration involve engaging with a broad spectrum of organizations—including companies, governments, NGOs and academia—to implement circular practices, for example, through industrial symbiosis (Fehrer and Wieland, 2021; Kaipainen *et al.*, 2023; Uusikartano, Saha and Aarikka-Stenroos, 2022). We also posit that scalability—an ecosystem's ability to scale up and build necessary resources, structures and capabilities—is also important in reaching systemic circular (Sgambaro, Kaipainen and Chiaroni, 2025) and net-zero goals (see Shaw *et al.*, 2018).

Managing capability development for systemic sustainability goals: A multilevel approach

Specifying how phenomena at different levels are linked in the multilevel management approach (Dagnino, Levanti and Mocciaro Li Destri, 2016; Kozlowski and Klein, 2000), we investigate multilevel capability development: how the level-specific capabilities are developed from one level to the next. According to Autio *et al.* (2018), organizations can jointly coordinate, induce, and steer actions, interactions and co-evolution to reach systemic goals, and we assume the same applies to managing collective capability development.

A central mechanism to coordinate and integrate individual organizational capabilities in value chains and ecosystems is orchestration, led by a central organization that facilitates inter-organizational collaboration (Linde *et al.*, 2021; Parida *et al.*, 2019; Sahasranamam and Soundararajan, 2022). Orchestration is particularly useful in ecosystem emergence, although the focus of managing multilevel capability development may shift from one central organization to multiple organizations as the ecosystem develops (Gupta, Panagiotopoulos and Bowen, 2023). Such multi-organizational joint management towards systemic sustainability goals can unfold in a more dispersed manner through coordination by multiple organizations when the interests of participating organizations diverge (Kaipainen *et al.*, 2023).

Whether through orchestration or more dispersed management, capabilities can be developed through collaboration and strategic partnerships to leverage complementary capabilities between organizations across the value chain and into the ecosystem (Aarikka-Stenroos *et al.*, 2022). Collaboration also enables knowledge-sharing for collaborative learning (Köhler, Sönnichsen and Beske-Jansen, 2022) to develop an ecosystem that addresses sustainability goals (Aarikka-Stenroos, Ritala and Thomas, 2021; Oskam, Bossink and de Man, 2021). Furthermore, collaboration facilitates the exchange of best practices, technological advancements and process improvements of individual organizations, driving the development of capabilities from individual organizations to the value-chain or ecosystem levels (Kaipainen *et al.*, 2023).

Insights into capabilities and their development from organizational to value-chain and ecosystem levels (Gupta, Panagiotopoulos and Bowen, 2023) are limited, and our understanding of capability development in practice is lacking: empirical evidence generated from applying the multilevel management approach to capabilities and their development towards systemic sustainability goals is narrow. With selected key references, Figure 1 summarizes our theoretical framework of the organizational, value-chain and ecosystem-level capabilities for achieving systemic sustainability goals as the three levels of a triangle (RQ1) and the development of these capabilities as the arrow growing from the organizational to the value-chain and ecosystem levels (RQ2).

Methodology

Research design and case description

A qualitative case research strategy was selected due to the novelty and complexity of the studied phenomenon and the limited coverage of real-life business cases related to net zero in the management literature (see, e.g., Naims, 2020). As our case, we selected a developing innovation ecosystem for carbon circulation in Finland that revolves around organizations, technologies and institutions developing and promoting the capture and utilization of carbon dioxide emissions from industries that cannot avoid emissions. In alignment with CE principles, *carbon circulation* enables industries with high commercial potential to close the loop and convert carbon dioxide emissions—that would otherwise be released—into a valuable feedstock (Naims, 2020; Sairanen and Aarikka-Stenroos, 2024). As carbon circulation practices remain largely pre-commercial (Chauvy and De Weireld, 2020; Kujanpää *et al.*, 2023),

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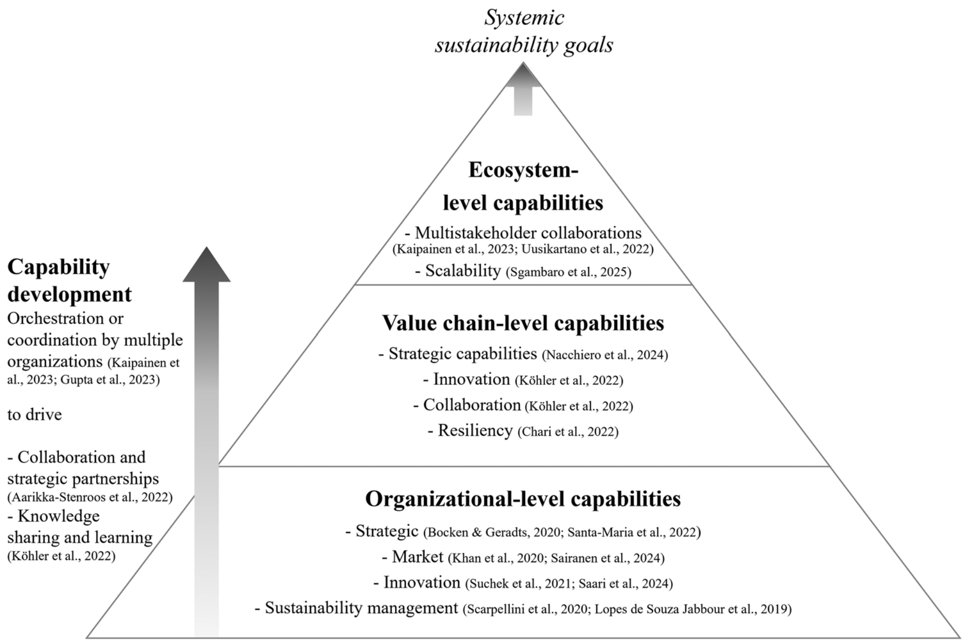

Figure 1. Theoretical framework: multilevel capabilities and their development from the organizational to the value-chain and ecosystem levels to reach systemic sustainability goals

we consider this an innovation ecosystem. The case ecosystem was selected based on the following key criteria: it (i) enables exploring capabilities for net zero via circularity at (ii) organizational, value-chain and ecosystem levels with (iii) sufficient data access in (iv) environmentally burdensome sectors, such as energy and forestry (which include some of the biggest carbon dioxide-emitting companies nationwide, encouraging proactive steps towards building a business case from carbon circulation). Moreover, the (v) institutional context needed to support capability development for net zero via circularity. Accordingly, a Finnish case was chosen due to Finland's national policies on climate change mitigation aligned with the EU Net-Zero Industry Act (NZIA, 2024), industrial focus on catalysing carbon circulation business (Kujanpää *et al.*, 2023), and highest position in the EU Eco-Innovation Index (which aims to assess EU countries' innovation performance to reduce environmental impacts; EEA, 2024) that supports carbon circulation as an eco-innovation initiative with high environmental impact.

To ensure insights into the capabilities explored at the three studied levels, we focused on two value chains embedded in the innovation ecosystem developing new solutions for carbon circulation (see Figure 2). Value chain 1 pursues the capture of carbon dioxide from waste incineration in the energy and waste management sector and its reuse to produce sustainable plastics with co-developed technologies. Value chain 2 aims to capture carbon dioxide from pulp mill emissions in the forestry sector and reutilize it to produce various fuels or chemicals. The case highlights the uncertainties in the value creation and capture of novel and pre-commercial technologies in an innovation ecosystem (Aarikka-Stenroos and Ritala, 2017). Being in the emergent stage of the value chains, many collaborations are still in the planning phase; hence, companies face high technology development and investment costs and must find customers willing to pay a premium for captured carbon as a raw material to justify final investment decisions. Thus, mutual reliance in a broader ecosystem encompassing organizations beyond the value chains is vital to facilitate material and economic flows and ensure knowledge and expertise exchange. The case ecosystem therefore also includes organizations not directly involved in the two value chains.

Data collection and analysis

The empirical data presented in Table 1 were collected from interviews and supporting secondary sources between December 2022 and May 2024. Our primary data comprise semi-structured interviews from 11 companies and 1 non-profit organization. The sampling was based on the organizations' significant roles in the emerging innovation ecosystem studied (see Table 2), shown by their meeting at least one of the following criteria: (i) participation in a national carbon circulation research project; (ii) initiated activities, strategic planning or project management of carbon circulation; and (iii) having the capability to develop carbon circulation technologies and supportive infrastructure; while being ready to share related information with this study. The selected organizations (see Table 2) within the

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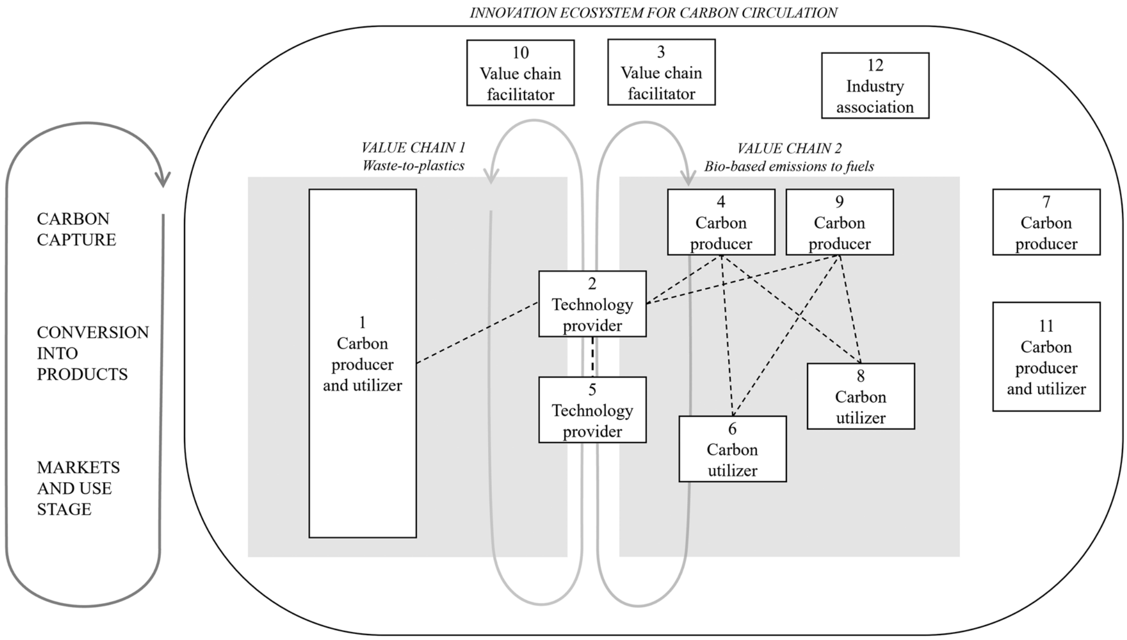

Figure 2. Studied innovation ecosystem for carbon circulation

Table 1. Data sources

Data type Primary data	Data: amount and description	Specification	Role in analysis
Interviews with ecosystem organizations	Interviewed organizations: $n = 12$ Total number of interviews: $n = 14$ Total number of interview participants: $n = 15$	Semi-structured interviews were conducted according to the interview guide. One person per eight companies and one organization were interviewed. Several managers participated simultaneously in the interview with companies 4, 5, and 10 (see reference number and company description in Table 2). Two rounds of interviews were conducted with managers of companies 1 and 4.	Interviews with individual organizations indicated their roles, responsibilities, and interconnections with others in the carbon circulation ecosystem. The interviews were conducted with (i) key organizations implementing/aiming to implement carbon circulation innovations and (ii) supportive organizations who can facilitate the ecosystem. The variety of interviewees allows extending a research perspective from the individual and value-chain levels to the ecosystem level.
Memos	Workshops, seminars or webinar presentations ($n = 9$)	Research and knowledge exchange events related to carbon circulation were attended from August 2022 to April 2024, and they involved diverse participants fromcompanies and academia.	Notetaking at the research seminars increased the trustworthiness of this study by validating evidence of the companies' activities regarding carbon circulation, interdisciplinary scientific funding, regulations, sustainability impact, innovations and business perspectives on carbon circulation.
Secondary data			
Media data	Eleven companies and one organization ($n = 12$): company/organization websites, marketing outlet documents	Eleven companies and one employer federation (see Table 2 for details).	Using additional data from the companies, such as promotion materials, enabled validating insights to how they implemented carbon circulation, their strategic plans, and changes, facilitating the exploration of capabilities development.
Publicly available reports and directives	Reports and directives ($n = 4$)	Kujanpää *et al.* (2023) European Commission (2020). *Climate strategies and targets*. European Commission (2021). *Sustainable carbon cycles*. European Commission (2022). *European Green Deal*.	Referring to the publicly available reports and EU regulations helped to complete the picture of the current and future perspectives on carbon circulation management, showing opportunities and challenges as the market for captured carbon and its derivatives develops.

case ecosystem represented five organizational roles: carbon producers (large incumbents generating carbon emissions), carbon utilizers (incumbents or new entrants processing and converting carbon dioxide into new products), technology providers, value-chain facilitators (companies focused on, e.g., innovation services) and one industry association. They shared a strategic interest in sustainability and the development of environmentally sound technologies. The study captures most of the organizations meeting the sampling

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Table 2. Interviewed organizations from the case ecosystem

Ref. number and organization	Main business activities	Carbon circulation activities in the ecosystem	Rationale to pursue net-zero targets	Interviewees: Number (n) and position
1 ***Carbon producer and utilizer*: Energy and waste management company**	Energy production; waste-to-energy; recycling materials such as plastic, metals and batteries; operation and maintenance services.	Implements waste-to-materials value chains to produce sustainable plastic by combining captured carbon emissions from waste incineration with green hydrogen.	Decarbonization of own industrial processes towards net zero and harnessing business opportunities from recycled carbon dioxide emissions.	$n = 2$ First-round and second-round interviews: Programme Director/Head of Waste to Materials Programme
2 ***Technology provider*: Carbon circulation technology developer**	Development and sales of a variety of technologies for the energy industry.	Develops and delivers three types of carbon capture technologies for multiple industries: power and heat, waste-to-energy and cement.	Facilitates decarbonization in the industrial processes for business customers.	$n = 1$ Forecasting and Analysis Director in Strategic Business Development
3 ***Value chain facilitator*: Consulting company**	Project development and management; technological consulting to build up hydrogen circulation ecosystems.	Develops and constructs whole value chains aiming for carbon circulation.	Develops and facilitates value chains for the production of hydrogen and hydrocarbons (e.g. methane) for industrial usage.	$n = 1$ Process Technology Manager
4 ***Carbon producer*: Forestry company A**	Production of board and pulp and related technology development.	Plans to integrate carbon capture innovations into the pulp mills to minimize the bio-based carbon dioxide emitted during production processes.	Strategic goal to be carbon-negative by 2050.	$n = 3$ First-round interview: Environment Manager; Development Manager. Second-round interview: Environment Manager; Project Manager
5 ***Technology provider*: Mechanical engineering and manufacturing company**	Mechanical engineering services and consulting for industrial organizations.	Engineering services for the development of carbon circulation technologies; market exploration to introduce carbon circulation technologies.	Seeking opportunities to widen product portfolio through carbon circulation technologies.	$n = 2$ Chief Calculation Engineer; Managing Director
6 ***Carbon utilizer*: Engineering and project management company**	Manages a project to construct a plant that will convert captured carbon dioxide to synthetic methane by combining it with green hydrogen produced on site.	Converts captured carbon and green hydrogen into synthetic fuels by utilizing 'power-to-x' technology to replace fossil fuels. Captured carbon dioxide is sourced from other companies to the plant for conversion.	Synthetic fuels have the potential to decarbonize multiple industry sectors (e.g. transportation) by substituting fossil fuels and are high-value products for sale on the market.	$n = 1$ Vice President of Business Development

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Table 2. (Continued)

Ref. number and organization	Main business activities	Carbon circulation activities in the ecosystem	Rationale to pursue net-zero targets	Interviewees: Number (*n*) and position
7 ***Carbon producer*: Waste management company**	Municipal waste management and recycling services.	Explores innovation and market opportunities to capture carbon dioxide at its own waste recycling facilities, purify it and further convert it into methane or other gases.	Seeking opportunities for additional profit streams while meeting the sustainability targets of decarbonization.	$n = 1$ Project Engineer
8 ***Carbon utilizer*: Chemical company**	Produces various chemicals, such as sodium chloride (used for bleaching of pulp), whose production generates hydrogen as a by-product.	Explores opportunities to monetize the by-product hydrogen by converting it with captured carbon into synthetic methane; seeks business partners who could provide the needed captured carbon dioxide.	Plans to engage in carbon circulation value chains to exploit the sustainability benefits of by-product hydrogen and to acquire expertise and technological capabilities to produce sustainable, high-value market products.	$n = 1$ Director of Hydrogen Business Development
9 ***Carbon producer*: Forestry company B**	Production of wood-based products such as timber, fibre, board, pulp and different types of paper products.	Plans to embed carbon capturing technology into production lines to recycle carbon dioxide emissions into products such as methanol, which could be sold to chemical industry customers.	Strategic aims to meet net-zero targets and become fossil-free by 2030.	$n = 1$ Director of Energy Efficiency Development
10 ***Value-chain facilitator*: Industrial project management company**	Organizing and managing industrial open innovation research projects.	Facilitates projects targeting carbon circulation technology implementation across industries.	Harnessesses capabilities to develop knowledge and manage projects to develop carbon circulation value chains, contributing to the decarbonization targets of various industries.	$n = 2$ RDI Manager; Head of Circular Economy
11 ***Carbon producer and utilizer*: Plastics and chemicals company**	Production of various chemicals and plastics for industrial use.	Aims to implement carbon capture and storage technologies in its production plant to reduce emissions; seeks carbon circulation business opportunities since the captured carbon dioxide may be integrable into its existing chemical production processes for sustainability benefits.	Aims to decrease its environmental impact by capturing its own carbon emissions; could exploit new revenue sources by utilizing captured carbon in production.	$n = 1$ Project Manager
12 ***Industry association*: Chemical industry federation**	An industry association that advocates and manages issues related to employment, regulations, and business to support its member organizations.	Participates in high-level research and development (R&D) projects, since carbon circulation is viewed as an alternative future source of carbon and a potential substitute for fossil carbon in the chemical industry.	Responsible for disseminating knowledge on how companies can decrease their environmental impact, including through carbon circulation innovations, and develop new ways of profit generation in the process.	$n = 1$ Chief Advisor on Energy and Climate

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criteria in this still-nascent case innovation ecosystem in Finland.

The interviews, targeting experts and managers responsible for the carbon circulation management and processes in their organizations, lasted from 45 to 110 min and were recorded and transcribed. Between one and three interviewees participated in a single interview. Two companies directly involved in the energy and forestry sectors, being the most central to the two studied value chains, were interviewed twice to deepen understanding of their intentions and approaches. As studies on carbon circulation as a business activity are lacking, the interview guide (see Table 3) enabled an inductive exploration of themes corresponding to the research questions.

The collected textual data were analysed through qualitative thematic analysis (Boyatzis, 1998). Following a data-driven approach, we first developed an overview of the organizations and visually mapped the innovation ecosystem to showcase the case boundaries of the carbon circulation processes driven by shared systemic goals, the emerging value chains inside the ecosystem, and the interactions and roles of the involved organizations, as recommended by Phillips and Ritala (2019; see Figure 2). Once we were familiar with the case ecosystem and data, we examined the emergent capabilities through thematic coding of the data, using the analysis software Atlas.ti, following the data structure outlined by Gioia, Corley, and Hamilton (2013). First-order codes were assigned to the expressions and aspects potentially related to multilevel capabilities and their management, such as organizational commitment to decarbonization or joint carbon circulation research activities. These were subsequently grouped into second-level themes representing the detected capability types and the activities bringing the capabilities together for value chains and the ecosystem. Capability types were accepted into our framework only if they were backed by first-order evidence from at least two organizations. Lastly, the capability types were grouped into aggregate dimensions representing capabilities at the organizational, value-chain, and ecosystem levels and the identified characteristics of capability development. Figure 3 illustrates a selection of codes and second-order themes to give an overview of the data structure (details in Tables 4–6).

During data collection and analysis, multiple measures were taken to enhance research quality. The empirical data were triangulated from primary and secondary sources to increase internal validity (Merriam and Tisdell, 2015). Each interview was analysed by multiple researchers, and the key codes identified were compared to ensure researcher triangulation. Furthermore, to confirm the novelty of empirically driven insights as they unfolded, we returned abductively to the theory to revise our theoretical background and analysis framework (Dubois and Gadde, 2002).

Findings

Capabilities at the organizational, value-chain, and ecosystem levels in an innovation ecosystem for carbon circulation

At the organizational level, our analysis revealed seven interconnected key types of capabilities to achieve net

Table 3. Key interview themes

Key interview themes addressing RQs	Interview sub-themes and their rationale
Carbon circulation and net-zero targets (RQ1)	• Motivation for net-zero targets: reasons for investment in carbon circulation innovations and their implementation; • Economic value creation: potential of developing economic value from carbon circulation activities; • Carbon circulation technologies: insights on enabling technologies to reach net zero and circularity targets and the business opportunities they can create
Organizational-, value-chain, and ecosystem-level capabilities (RQ1)	• Multilevel capabilities: assessment of existing organizational, value-chain, and ecosystem capabilities supporting companies' carbon circulation implementation; • Required capabilities: missing or needed capabilities potentially hampering carbon circulation implementation and management; • Carbon circulation technologies' impact on business models: status of technological advancement and description of the intended business models to develop the needed multilevel capabilities
Value-chain and ecosystem management (RQ2)	• Organizational capability management: organization's management and communication activities supporting capability development; • Multi-organizational interaction: organization's role and interaction with others in the value chains and ecosystem, facilitating carbon circulation and related innovation activities; • Interaction facilitation: specifics of organizations' collaboration in value chains and ecosystems
Regulatory and market landscape influencing capability development (RQ2)	• Market forces and regulations: market and regulatory effects on carbon circulation value chains and ecosystem emergence and management; • Regional specifics: characteristics of country location and political context influencing capabilities development and management

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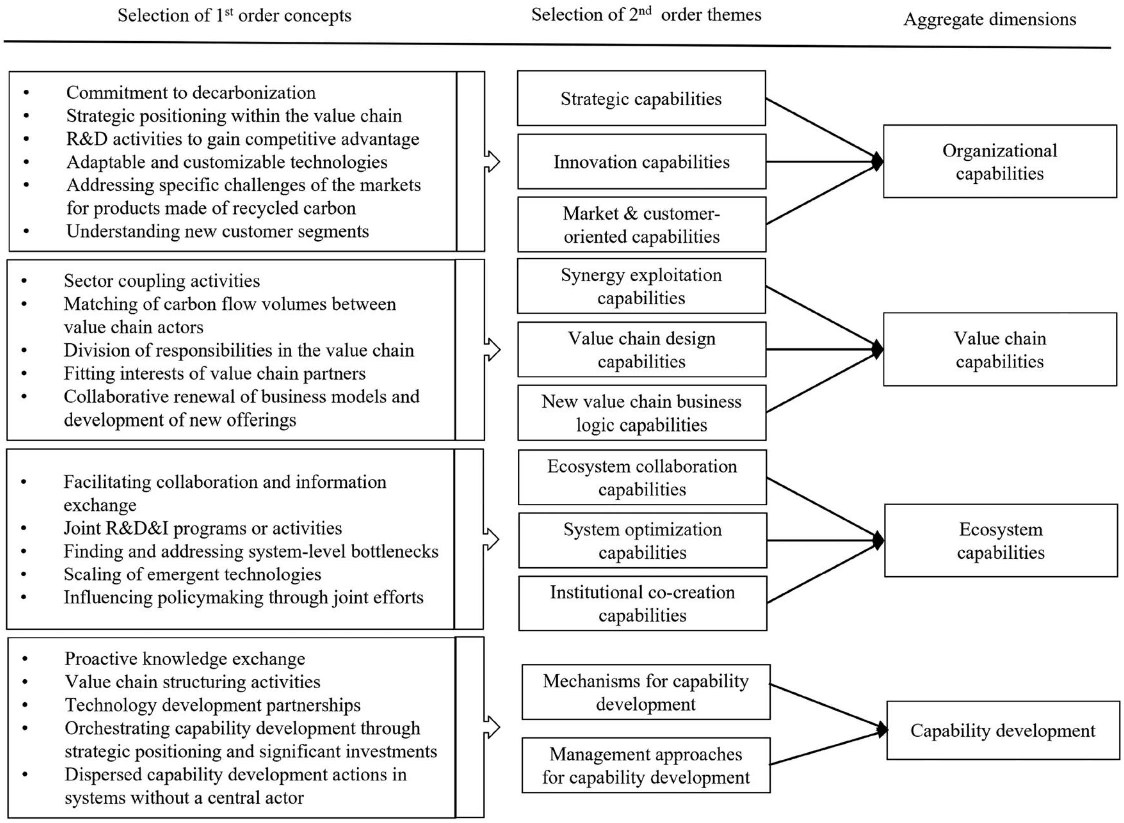

Figure 3. Data structure

zero via a CE, summarized in Table 4 with illustrative examples from the data.

Firstly, organizations need strategic capabilities to create viable carbon circulation value chains from scratch, position themselves wisely and justify significant investments in the new value chains and technologies. These capabilities are particularly important for the organizational roles of carbon producers and carbon utilizers, who make the largest investments and can often choose to vertically integrate the carbon circulation business. Secondly, market- and customer-oriented capabilities are crucial to commercialize novel products based on circulated carbon that compete with existing fossil-based alternatives in an emergent market. To succeed, carbon processors and other companies must understand the factors that steer market development and customers' value perceptions. Third, innovation capabilities are necessary for technology providers and carbon processors to remain on the front foot in the race to net zero with their R&D. Agile innovation processes and versatile technologies help companies secure a foothold in the rapidly developing markets of novel low-carbon products.

Fourthly, risk management capabilities emerged from the data as a dynamic shift to net zero requires companies to balance multiple significant risks related to unexpected changes in, for example, technologies, policy development and market demand. This capability type was found to be crucial across all organizational roles within the case ecosystem. The fifth type is sustainability management capabilities. Expertise in assessing sustainability effects is valuable to profitability calculations, regulatory compliance and optimizing branding benefits. Sustainability management capabilities were found critical for emitters, but important for all organizational roles. Sixthly, policy-related capabilities were found to be vital for organizations to profoundly understand the current and possible future business environment of carbon circulation and analyse value creation potential accordingly. Since the market and technology development for many circularity-based solutions for net-zero are heavily steered by different policy instruments, these capabilities are needed throughout the ecosystem. However, value chain facilitators and industry associations can play crucial roles in collecting, synthesizing and distributing policy-related information. Finally, operational and logistical capabilities are important to optimize new material and energy flows and process integration. Carbon producers and utilizers need these capabilities to build feasible business cases around novel carbon circulation businesses.

At the value-chain level, we identified five types of key capabilities (Table 5). Value chain capabilities are rooted in organizational capabilities, which must be built on or

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Table 4. *Key types of organizational capabilities to reach net zero via a CE*

Capability type	Key capabilities	Relevance for reaching net zero via circularity	Data example
Strategic capabilities	Commit to decarbonization	High-level commitment to emission reductions is critical to incentivize action	Organization 1 highlighted the role of the company's strategic carbon neutrality targets in setting the ambition to capture and recycle carbon dioxide emissions.
	Find an optimal position in the value chain	When forming value chains for carbon circulation, companies must position themselves carefully and take important insourcing and outsourcing decisions.	'We are considering partnering up with different partners for some of the value chain, because this is a huge undertaking for us and we cannot develop technologies for all of the process steps'. (1) 'Our position in the value chain is that we produce board and pulp, and their production causes some carbon dioxide emissions […] In the future, different organizations or partners [are needed] who further process carbon dioxide which we capture or they capture [from our emissions]. They could be e-fuel or e-methanol producers'. (4)
	Find optimal sources of carbon	The sustainability and economic viability of carbon circulation are greatly affected by the type, location, volume and other characteristics of the emission source, which companies must consider carefully.	'I would […] like to use the biogenic [carbon] anyway, because there's plenty of it available, you just need to capture it'. (8) Organization 6 is considering whether it is better to import carbon dioxide captured elsewhere or capture it locally, even if not all of it could be processed.
	Take informed decisions for carbon utilization	Captured carbon can be utilized in a versatile manner, but each product has its own set of opportunities and risks. Companies converting the carbon into new goods must carefully consider these and take informed decisions about what to make with carbon.	'At the moment, we are probably considering methanol as the most attractive product because it's so versatile. But if we are considering, for example, ammonia, the market environment is already a lot more challenging because there are not so many use cases for ammonia'. (6) 'Production of synthetic methane is one of the [business] perspectives. We would like to add production of traffic fuel methane'. (7)
	Devise an optimal deployment strategy	Novel and capital-intensive carbon circulation technologies should be rolled out in a balanced manner, exploiting opportunities while keeping financial risks within desirable levels.	Organization 4 highlighted that one of its mills could be the first pilot site for carbon capture. 'We need to see the technologies in action, we need to demonstrate the value chains, and at the moment we have only some small pilots that are focusing on the technology of carbon capturing'. (10)
	Justify significant investments	To make investment decisions on expensive carbon circulation technologies, careful analysis and risk tolerance are required to financially justify significant investments.	'Of course, you have to invest as well. These are commercial things also. If something is there that is not profitable at all, it's difficult to justify to yourself and to others that we should do something like that'. (4)
	Optimize scale	Significant resources are needed to achieve the scale needed for cost efficiency in carbon circulation operations.	Organization 6 highlighted that a larger capture machinery will result in capturing carbon more cheaply but would require further large-scale investments into synthetic fuel and hydrogen production (to convert the captured carbon).

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Table 4. (Continued)

Capability type	Key capabilities	Relevance for reaching net zero via circularity	Data example
Market- and customer-oriented capabilities	Shape the emergent market	Pioneering companies can affect the development of the market for products made from captured carbon.	'We are at this stage when we are developing the market. It's not so obvious, that is okay, we produce the renewable product and then we just sell it to the market. We don't have the market for those products yet, everywhere, mainly because of the higher price'. (6)
	Navigate specific challenges of emerging low-carbon product markets	The emerging market of carbon circulation solutions implies that pioneer companies face challenges of cost-competitiveness and dynamically changing demand that they must learn to navigate.	'When there is not enough demand, the costs are not yet where they should be, and when the first investments are made, they are not the largest ones, and you have challenges with the cost-competitiveness compared to the fossil alternatives'. (6)
	Understand customer segments	When facilitating decarbonization for the downstream value chain, it is crucial to identify the beneficiaries correctly and determine their willingness to pay for added sustainability within different customer segments.	Organization 6 emphasized the importance of identifying those customers willing to bear the additional cost of the sustainable products and the situations affecting that willingness. 'New EU packaging and packaging waste regulation is supporting the increasing use of renewable and circular plastic solutions in packaging. Several customers already have pledges to use renewable and circular solutions by the end of the decade. There is also growing interest in carbon capture and utilization -based solutions, and products are already available; however, the demand is still very limited due to unclear regulation and a relatively high cost structure'. (11)
Innovation capabilities	Carry out agile technology development	In the early commercialization phase of carbon circulation technologies, agile and well-designed R&D activities with sufficient technological expertise can create a competitive edge.	'We want rather to be more agile and dynamic and do small-scale piloting and learn from that, because all the learnings we get will help us in developing the next phases. So, we have deliberately decided to take a different approach and be as agile and open and transparent as we possibly can'. (1)
	Pursue innovation to uncover new decarbonization pathways	Companies hope to find competitive advantage from novel decarbonization strategies in the face of an inevitable transition.	'This picture [of decarbonisation pathways] is something our member companies have been studying a lot, because they have understood that fossil-based raw materials are going to end sooner or later, so they have now started to study the raw materials of the future'. (12)
	Promote technology adaptability	A carbon circulation technology that can be fitted for multiple industries or use situations is often commercially advantageous.	Organization 2 stated that its carbon capture technology fits many industries, from traditional power plants to cement, steel, natural gas processing, and hydrogen.
Risk management capabilities	Choose the correct technology	Since many decarbonization technologies are rapidly emerging, technology risk is often large.	'You have to be sure about the technology and, of course, then the pros and cons of different technologies, because this is really something new'. (4)
	Manage market uncertainty	In the emerging market of carbon circulation and solutions towards net zero, things develop fast, and policy-driven market risk is often considered significant.	'Being the first, of course, gives a certain advantage, but on the other hand, you have to live in the developing regulatory environment, and it throw up a lot of challenges, for example, regarding how the carbon dioxide market is developing'. (6)
	Ensure that environmental permitting is smooth	It is important to ensure that carbon circulation technologies can be employed smoothly without delays due to permitting processes.	'Whenever that kind of new technology is put to use, it will have to go through permitting processes. The environmental permit has to be updated, and if there will be more emissions into water, for example, it might be a challenge to have the right levels'. (4)

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Table 4. (Continued)

Capability type	Key capabilities	Relevance for reaching net zero via circularity	Data example
Sustainability management capabilities	Assess the sustainability impacts of carbon circulation	Being able to comprehensively and transparently verify the environmental benefits is necessary for decision-making and carries potential benefits in terms of, for example, branding and regulatory compliance.	Organization 6 emphasized that the ability to calculate and predict exact emission savings is also important in calculating profitability, for example, due to savings from emission trading.
	Employ sustainability benefits in branding	Using climate change mitigation through carbon circulation to strengthen the company brand creates business benefits.	'[…] the image and the reputation that you really do new things. Not only improving the old ones but trying to solve challenges which are very global'. (4) 'Brand is one of the main reasons [to engage in carbon circulation] besides the new business opportunities'. (7)
Policy-related capabilities	Awareness of regulation	Companies need to consider complex and far-reaching regulations to form a deep understanding of different business cases for carbon circulation.	'As the regulation states, after 2040, only bio-based or directly air-captured carbon dioxide is available [for certain applications]. And in 2040, even though it seems to be far away, when you are looking at the investment horizon of these kinds of things it's very short. It's basically restricting the investments of different companies to options that will still be acceptable after 2040'. (6)
	Anticipation of policy developments	The better a company can anticipate political and regulatory developments that shape the market and business case of carbon circulation, the better and more timely investment decisions it can make.	'Legislation can influence these incentives. It's more a question of when it will happen. There will come a point in time when it's no longer feasible to use fossil raw materials'. (1)
Operational and logistical capabilities	Seek and exploit synergies	The ability to, for example, source needed utilities for free or monetize the side streams of carbon circulation processes increases the economic viability of such processes.	'I would say that [carbon capture] fits quite well in these forest industry or pulp mill operations. Quite a lot of utilities are already available. We have a lot of water. We have a lot of energy, which we produce by ourselves. And of course, we have quite good connections to the grid to get the electricity to the mill site and so on. So, it's easier than somewhere else'. (4)
	Integrate processes	Integration of, for example, carbon capturing technology into existing processes requires optimization in terms of space usage, mass and energy balances, etc.	'We have all these utilities here, so, of course, you need to make necessary connections and check the balances of all the processes together and so on'. (4)
	Optimize system logistics	When carbon dioxide is converted into fuels and materials, it needs to be combined with green hydrogen in water-intensive processes. Companies must determine the optimal way to move these utilities around.	'The closer we can locate both the carbon capture and the methanation or the methanol synthesis, the better. And, regarding production of hydrogen, the ideal situation would be that it is located as close to the [capturing] facility as possible'. (1) Organization 9 was trying to determine the optimal solution for transporting carbon dioxide, hydrogen, and utilities (particularly water) in a new system of flows.
	Exploit favourable production locations and manage product-to-market logistics	Being able to use existing logistics assets to circulate carbon and find locations where production conditions are favourable can considerably lower total costs	'The port is just next to us, and this [boat operator X] is also 100 per cent owned by us. […]The boat is there, and it can be used'. (4) Organization 11 has production sites near ports in multiple countries and can thus effectively utilize carbon maritime logistics.

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Table 5. Key types of value chain capabilities to achieve net zero via a CE

Capability type	Key capabilities	Relevance for reaching net zero via circularity	Data example
Value chain sustainability management capabilities	Ensure holistic environmental sustainability of the value chain	Reaching systemic net-zero goals should not compromise other environmental sustainability goals at the value-chain level	'The sustainability is discussed, whatever we do, starting from the forestry, our raw materials, and then ending up with what happens to our products. […] So, in the whole value chain, sustainability is the focus'. (4) 'If we were to produce methanol, that is then a completely different value chain. […] We indirectly use quite a lot of methanol in our products and are looking to have products with a lot better sustainability profile'. (8)
Value chain risk management capabilities	Manage multilevel uncertainty where, inter alia, policy developments can change the market and consequently affect technology choices	A carbon circulation value chain must be aware of multiple simultaneous risks and use robust reasoning to choose and lock into a technology or decarbonization pathway.	Organization 2 argues that the main risk for carbon capture-based value chains is the rapid development of alternative solutions, such as hydrogen reduction in the steel industry or alternative energy carriers in the airline industry.
	Assess which decarbonization pathway will be used	When industries first seek optimal decarbonization pathways (such as carbon capturing or materials innovation), it is key for value chains to correctly recognize development trends and make business decisions.	Organization 1 decided to build a value chain to convert captured carbon dioxide into plastics because it believes that demand for fossil-free plastic will surge in the future.
Synergy exploitation capabilities	Find opportunities for sector coupling and industrial symbiosis	To attain competitive advantage, novel circular value chains for net zero must exploit new cross-sectoral material and energy synergies.	Organization 2 presented various novel sector-coupling opportunities with clear business benefits, including using side product oxygen from hydrogen electrolysis for oxy-fuel carbon capture processes. 'Typically, there are some chemical plants next to the [pulp] mills, because there are synergies. We have chemical producers next to us [that buy] one of the side streams from the pulp mill process, but we also get pitch oil from them that we burn, that is biogenic fuel for us, and we have replaced heavy fuel oil with that. So, it's a good synergy. The same thing with carbon dioxide'. (4)
Value chain design capabilities	Match the offer and demand of resources throughout the chain (e.g. volumes of carbon dioxide)	For carbon circulation value chains to function, no company should end up with excessive under- or overcapacity.	Organization 8 discussed the difficulties of finding a suitable value chain due to the rather small scale of the operations planned for carbon dioxide conversion, which does not match well with the capture scale of big carbon producers.
	Understand and ensure a fair division of benefits and additional costs	Ambiguity often exists regarding which party in the carbon circulation value chain in practice gets the environmental benefit, perceives added value, and can bear a possible additional cost of the product.	Organization 6 highlighted that the value perceptions of different parties are difficult to grasp for different products. For example, methanol can be used as a base to produce a multitude of materials that are later used in multiple industries, and companies in all these steps could perceive a variety of benefits. These hard-to-attribute benefits, in turn, affect the willingness of different parties to pay a premium or invest and thus the feasibility of the whole value chain.
	Have the flexibility to produce different products	A carbon circulation value chain is more competitive if it can react to changing resources or market situations by having various options for the final product and division of responsibilities.	'If we think about capturing the carbon dioxide and then combining that with hydrogen, then you will be able to produce hydrocarbons, so basically the building blocks, whether it's then materials or chemicals. You can use different conversion technologies to create different types of chemicals or plastics. […] So we are evaluating different options together with different partners'. (1) 'Methanol can be used to produce plastics, solvents, makeups, many different things. Ammonia can be mainly used as a fuel or then in the fertiliser industry'. (6)

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Table 5. (*Continued*)

Capability type	Key capabilities	Relevance for reaching net zero via circularity	Data example
New value-chain business logic capabilities	Develop the economic feasibility of carbon circulation in a novel way	Value chains for carbon circulation may require the renewal of old business models or development of new ones, such as selling carbon, buying carbon circulation services, or transforming carbon into market value products.	'Our business model is based on the idea that we are going to install and operate the carbon capture plant as well as the hydrogen production plant and the synthetic material production plant, and then basically sell the end products to the customers. But it depends on the willingness of the carbon dioxide emitter to participate in this value chain. The targeted business model for the carbon capture may also be different, and the interfaces between the different partners within the value chain can be as well'. (6) 'We are the one that buys the [carbon circulation] service, because we have the gas but not the expertise or the process'. (7)

scaled into an interorganizational setting. The following subsection discusses what capabilities can be developed from the organization to the value-chain level according to the empirical evidence.

Firstly, sustainability management capabilities are also required at the value-chain level to guarantee that holistic sustainability needs are met by the chain, and no sustainability goals are compromised in the pursuit of net zero. Secondly, value-chain risk management capabilities are needed to scale up from the organizational to the value-chain level because many of the most impactful decisions to manage risks related to dynamic externalities (e.g. regulation, market demand or technological innovation) are taken at the value-chain level and concern value-chain configuration. Thirdly, value chains need synergy exploitation capabilities, which partially build on operational capabilities drawn from the organizational level. This refers to the abilities of the value chain to exploit, in particular, sector coupling and industrial symbiosis to increase efficiency and minimize waste from material and energy flows within the novel intra- and cross-industrial collaborations embedded in carbon circulation value chains. Synergy exploitation capabilities can considerably increase the technical and economic feasibility of carbon circulation value chains.

The fourth type, value-chain design capabilities, is closely related to the third and not only fosters a value chain's competitiveness but, importantly, guarantees its ability to deliver balanced benefits and respond to the needs of all its participants. Value-chain design capabilities are needed because the benefits of decarbonization are often defined by ever-developing rules and frameworks, such as emission accounting, which can create ambiguity regarding the true beneficiaries within a carbon circulation value chain. Finally, new value-chain business logic capabilities build on particular strategic and customer-oriented capabilities at the organizational level and refer to the ability of a value chain to adopt a combination of new business models based on, for example, selling and refining captured carbon or preventing emissions. We found that at the value-chain level, novel business logics need to be co-developed among the value chain organizations to attain true competitiveness and profitability.

In conclusion, many capability types share similarities at the organizational and value-chain levels. However, as value chain capabilities are collective in nature, they often have broader impact potential than their counterparts at the organizational level. For example, sustainability capabilities can address broader systemic sustainability impacts when applied collectively by the entire value chain. On the other hand, some organizational capabilities are necessary prerequisites for building up value chain-level capabilities. For example, effective synergy exploitation through sector coupling in the value chain can hardly be achieved without strong operational and strategic capabilities among the individual organizations.

Finally, at the ecosystem level, we identified five key capability types that reflect the abilities of the entire innovation ecosystem to combine their resources for systemic sustainability goals. They are presented in detail in Table 6.

Firstly, the ecosystem collaboration capabilities identified in our case refer to an ecosystem's ability to facilitate collaboration to accelerate innovation and scale up business towards net zero. They build on, for example, value-chain design and new value-chain business logic capabilities at the value-chain level. Secondly, systemic knowledge development capabilities allow an ecosystem to inform participants not only about global and regional development trends but also about explicit and hidden systemic limitations (e.g. the availability of biogenic carbon dioxide) that companies must consider when engaging in carbon circulation businesses. Relatedly, an ecosystem also needs system optimization capabilities to identify and address sys-

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Table 6. Key types of ecosystem capabilities to achieve net zero via a CE

Capability type	Key capabilities	Relevance to reaching net zero via circularity	Data example
Ecosystem collaboration capabilities	Produce joint R&D and innovation programmes	Development of technologies for carbon circulation can be accelerated through systemic collaboration.	Organization 2 had entered into a partnership with another company to develop and pilot a new type of hot potassium-based carbon capture technology; the project had recently acquired EU research funding.
	Facilitate formal and informal communication	Channels for information exchange and cooperation are essential to catalyse systemic changes towards net zero.	'I think cooperation is the most important, cooperation capability'. (10) 'We are collaborating [on carbon circulation] with different universities and different small-sized companies both in Finland and in Europe'. (1)
Systemic knowledge development capabilities	Generate and spread understanding of systemic development trends	To make informed decisions on carbon circulation, companies need guidance and access to the latest information from the ecosystem.	Organization 12 was increasingly focusing on distributing the latest decarbonization-related information throughout the ecosystem, putting together and providing tailored resources. Organization 1 emphasized that it wants to promote its carbon circulation business to raise awareness so the industry can adopt carbon capture and utilization technologies on a larger scale.
	Generate and spread understanding of systemic limitations	Ecosystems should provide their organizations with the necessary awareness of limitations, such as types of carbon available or legislation that sets indirect limitations to carbon circulation.	'I just realised that, for example, the energy efficiency directive is connected to carbon capture and utilization because it's basically capping the energy consumption in the EU. So, if you are not allowed to use more energy, how are you going to invest in carbon circulation or hydrogen or anything like that? That's a good example of legislation that shouldn't be related to carbon circulation, but it is, indirectly'. (12)
System optimization capabilities	Scale up technologies and increase their efficiency, lowering costs	In emerging carbon circulation ecosystems, broad collaboration (and development funding) is typically needed to achieve rapid, cost-effective development.	'These [carbon capturing] technologies need to scale. […] When you have the scale to do something, then the cost goes down'. (2) 'I think many of the technologies are there, but what is really needed are these kinds of complete, big-scale projects that are somehow showing the way. […] I think that something that would be needed are these kinds of demonstration projects that then others can follow'. (8)
	Eliminate systemic bottlenecks	When new carbon circulation systems emerge, a great deal of infrastructure and technology must be developed simultaneously, which underlines the importance of identifying and eliminating bottlenecks in the system	Organization 2 pointed out that availability for carbon storage locations is a systemic bottleneck that ecosystems must address to avoid delays in market development.
Institutional co-creation capabilities	Influence policymaking	In a dynamically developing and complex regulatory environment concerning carbon circulation, ecosystems can create crucial benefits for their organizations by influencing policy and regulatory development.	'We are trying to have, some call it lobbying, but you could also call it information-sharing. Basically, we are the bridge between our member companies and politicians. So, we can help our member companies in that way'. (12)
	Align with regulatory development	Ecosystems should create awareness of current and potential future regulations to help organizations exploit opportunities and mitigate policy risks.	Organization 12 stressed the importance of closely following and assessing political discussions in the EU, particularly after the 2024 elections. Organization 6 described the complex policy and regulatory landscape (including, e.g., sectors under the emission trading system and renewable energy directive) that dynamically steers market demand and has complex implications for the innovation ecosystem.

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Table 6. (Continued)

Capability type	Key capabilities	Relevance to reaching net zero via circularity	Data example
Regionality capabilities	Exploit competitive regional advantages	Ecosystems can embrace the unique opportunities that different countries and geographical areas present for the carbon circulation business.	Organization 9 emphasized that carbon circulation is a huge opportunity for the Nordic countries due to the big point sources of bio-based carbon dioxide and abundant renewable energy. Organization 6 highlighted that there are social sustainability as well as environmental benefits from relocating fuel production from the Middle East to Finland and similar countries, where the regulatory and business environment is better known.
	Effectively utilize (and develop) regional physical and market infrastructure	Ecosystems should take advantage of existing infrastructure that can enable carbon circulation and fix potential technical issues.	Organization 9 pointed out that Finland possesses the basic requirements to facilitate carbon circulation and the decarbonization of energy, as it has a strong national electricity grid and an open electricity market.

temic bottlenecks, such as locations for carbon storage, and enable cost-efficient technology diffusion. These capabilities link with operational capabilities at the organizational level and value-chain design capabilities at the value-chain level.

Fourthly, policy-related capabilities at the organizational level can accumulate and translate into institutional co-creation capabilities at the ecosystem level, which are essential in net-zero settings. Since policy and regulation on circularity and decarbonization are developing dynamically, an ecosystem capable of coordinated advocacy can steer policy development in favourable directions, such as promoting carbon dioxide as a resource rather than waste. Lastly, regionality capabilities refer to the ecosystem's ability to leverage and develop the surrounding national or geographical environments. For example, Finland's strong national electricity grid provides a competitive advantage to carbon circulation ecosystems while requiring determined and continuous further development.

To summarize, some ecosystem-level capabilities for achieving net zero via circularity, such as institutional co-creation capabilities, build on organization- and value-chain-level capabilities that can generate broader impacts when aggregated into a capability of the entire ecosystem. Others, such as regionality capabilities, are grounded in the characteristics and positioning of each ecosystem. Ecosystem-level capabilities require participants to transcend value chains and industry sectors to transform the overarching business environment in favour of circularity and net-zero goals.

Managing capability development in an innovation ecosystem for carbon circulation

Apart from the specific capabilities identified at the three levels, we explored capability development from (i) the organizational to the value-chain levels and (ii) from the organizational and value-chain to the ecosystem levels.

Regarding the first, we identified two mechanisms in value chains 1 and 2. The first is *knowledge-sharing*, namely, proactive communication between organizations to generate a better understanding of the (potential) organizational capabilities, such as operational competences related to material flows, enabling the development of value chain-level capabilities, such as industrial symbiosis activities. The second is *value-chain design*. Value-chain design activities, such as seeking suitable partners and organizing them into a chain that suits all participants' needs, are not only a standalone value-chain capability type but also directly contribute to the emergence of a variety of value chain-level capabilities grounded on the joint understanding of organizational capabilities.

Furthermore, we identified two approaches to managing capability development from the organizational to the value-chain levels. Here, a significant difference between the two value chains of the innovation ecosystem emerged (see Figure 2). Value chain 1 (waste to plastics) managed capability development through orchestration, with organization 1 playing a central role for multiple value-chain functions, including the capture of carbon dioxide and its conversion into products. This is because one incumbent (energy and waste management company, see Table 2) possessed most of the key capabilities for managing the different functions of the value chain, including the capability to coordinate the chain development in the direction that suits its own strategic intents. Here, the incumbent can relatively easily identify and seek the capabilities still needed from other organizations to complete the value chain. This may explain why we found value chain 1 at a more advanced stage of taking carbon circulation innovations to the market than value chain 2. Relat-

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edly, value chain 2 enabled us to observe dispersed capability development. In contrast to value chain 1, the incumbent (forestry company A) producing carbon did not have the capabilities for carbon utilization and commercialization. Hence, more diverse organizations with different interests and capabilities were involved and attempted to find common touchpoints through research projects. Notably, no organization was taking the lead to pursue potential first-mover advantages in the emerging markets. Even the largest incumbents, which were not restricted by resources, were concerned about the technology development and financial investment risks.

Regarding capability development from the organizational and value-chain levels to the ecosystem level, the innovation ecosystem for carbon circulation manifested three mechanisms. *Knowledge-sharing* was again identified as important, but to develop capabilities at the ecosystem level, it was accompanied by *collaborative sensemaking*: a joint effort to develop a shared and actionable systemic vision of the situation and needs of the innovation ecosystem. These two mechanisms particularly manifested in diverse cross-sectoral and cross-chain meetings and events. Such occasions allowed different value chains and organization types to initiate new formal cross-chain collaborations and establish a joint understanding of systemic trends, development needs, and competition among different decarbonization pathways. Furthermore, *institutional co-creation*—itself posited as a key capability for the ecosystem—was identified as a mechanism that diverse organizations leveraged to pursue the systemic goal of net zero. Here, organizations across the ecosystem collectively deliver joint efforts to shape the regulatory and policy development as well as the norms for institutionalized carbon circulation.

In contrast to the value-chain level, the ecosystem level manifested a dynamic hybrid of orchestrated and dispersed capability development. For example, to develop ecosystem collaboration capabilities, dispersed communication facilitation was used to create links in the case innovation ecosystem beyond distinct value chains, after which organization 10 could take a central orchestrating role to initiate a joint research programme. Ultimately, the orchestrated and dispersed communication actions mutually reinforced one another to build up collaboration capabilities.

Discussion

Our analysis of a carbon circulation innovation ecosystem enabled the identification and structuring of multilevel capabilities and their development in addressing the systemic sustainability goals of net zero via circularity. The findings from the empirics are conceptualized in Figure 4 and discussed in the next subsections.

Multilevel capabilities for systemic sustainability goals

The framework depicts (i) the *key capability types* that play a fundamental role in approaching net-zero goals via circularity at the organizational, value-chain, and ecosystem levels and (ii) the main capability development mechanisms across the three levels. Highlighted in italics are the capabilities that sugappeared to be novel to the literature. Although these capabilities partly overlap across the levels, they manifested differently at each level. For example, strategic and market-oriented capabilities at the organizational level that largely deal with goal-setting by single organizations were developed into value-chain design capabilities at the value-chain level, focused on organizing and structuring. In contrast, sensing-oriented policy-related capabilities at the organizational level translated into more transformative institutional co-creation capabilities at the ecosystem level.

At the *organizational level*, prior research has discussed strategic, market, innovation and sustainability management capabilities via circularity (see Figure 1). Our findings bring forward three important types of organizational capabilities not usually presented: operational and logistic, risk management and policy-related capabilities. Firstly, operational and logistical capabilities are often positioned in the management literature as the foundation of capabilities with a strategic nature, such as dynamic capabilities (Ambrosini, Bowman and Collier, 2009; McKelvie and Davidsson, 2009). However, the CE literature has addressed them more implicitly, for example, when discussing operational efficiency to reduce waste and improve resource use (Kaipainen and Aarikka-Stenroos, 2022; Konietzko, Bocken and Hultink, 2020). Given that dynamic capabilities are gaining traction in the CE literature (Bocken and Geradts, 2020; Santa-Maria, Vermeulen and Baumgartner, 2021), it is important to highlight that operational and logistical capabilities serve as the underlying foundation enabling more strategic sensing, seizing and transforming capabilities in a CE. Secondly, developing novel businesses around the CE required the studied case organizations to develop novel risk management capabilities as an emergent finding from the data, for example, for environmental permit processing, to ensure long-term business feasibility. Thirdly, the awareness and anticipation of the policy and regulatory environments, such as the development of emission trading systems or carbon taxation, play a key role for organizations to sense how their business environments are evolving due to systemic sustainability goals. Although regulations and policies are often recognized as important for circularity (Kaipainen *et al.*, 2023), the capabilities

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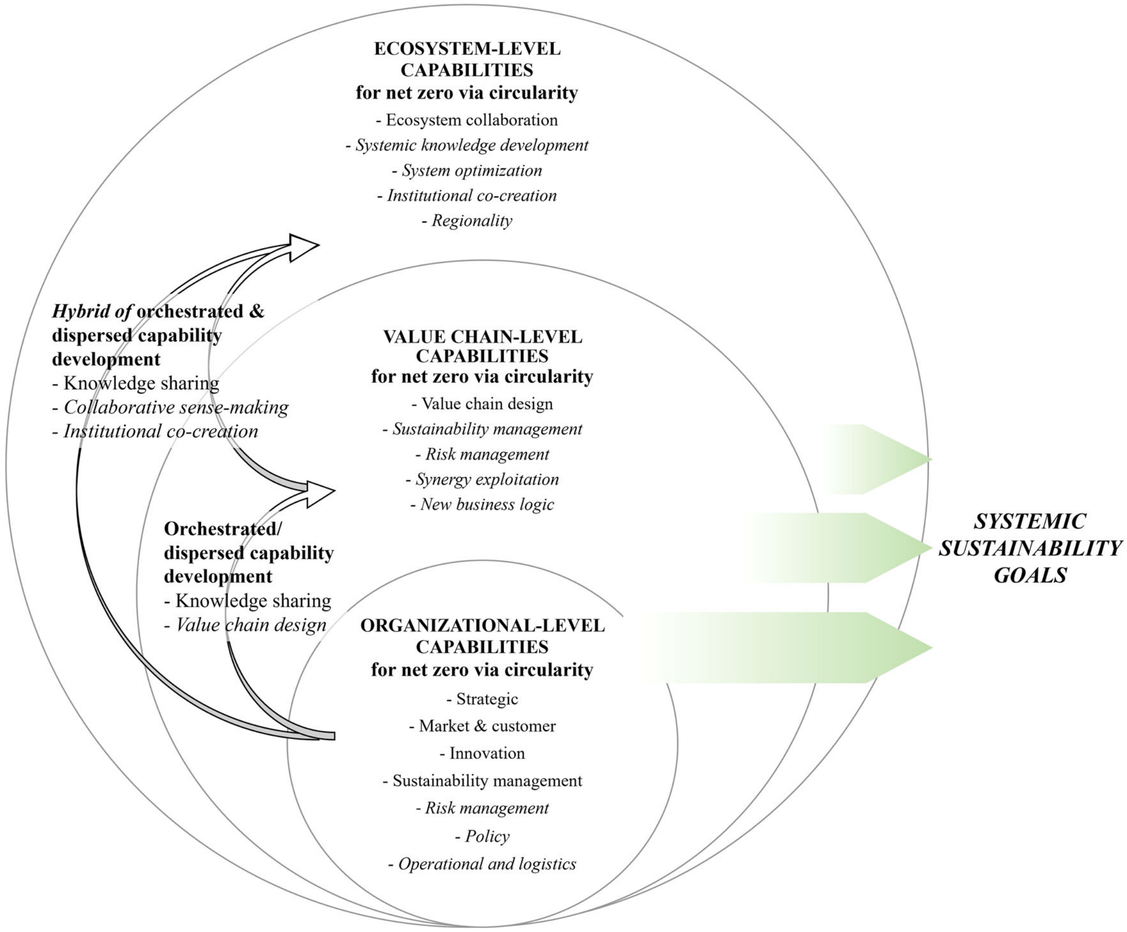

Figure 4. Framework for managing multilevel capabilities and their development to meet systemic sustainability goals

needed to address them are more rarely considered as an issue for individual organizations. Furthermore, we found that strategic capabilities to some extent span other capability types at the organizational level due to the strategic nature of the organization's decisions when engaging in novel carbon circulation business. For example, the market-oriented capabilities and innovation capabilities that organization 6 leveraged to craft its market positioning and technological edge in a very emergent market were grounded on strategic capabilities, that is, choices regarding, for example, value-chain positioning, carbon sources and carbon utilization pathways.

At the *value-chain level*, we find that value chains that pursue net zero via circularity require novel capabilities for value-chain sustainability and risk management, synergy exploitation and new value-chain business logics. This adds a broader spectrum of chain-level capabilities to prior CE research, which mainly addresses collaborative innovation and value chain design (see Köhler, Sönnichsen and Beske-Jansen, 2022; Nacchiero, Massari and Giannoccaro, 2024). The complexity of systemic sustainability challenges requires several organizational-level capabilities, such as risk management and sustainability management, to be scaled from the organizational level for the entire value chain to be highly effective. Value-chain design capabilities, in particular, such as supply chain re-conceptualization (Beske, 2012), promote efficient resource use (e.g. by matching volumes of captured and converted carbon dioxide) while maintaining the flexibility to deal with potential policy changes or market disturbances (e.g. by developing capacity to simultaneously produce several products from recycled carbon). Interestingly, new business logics stand out at the value-chain level as a specific, novel type of strategic capability (see Nacchiero, Massari and Giannoccaro, 2024), as a result of organizations reconfiguring their business models and operations to fit the systemic goal of achieving net zero. For example, if a producer of biogenic carbon dioxide aims to monetize carbon emissions by capturing and selling them for utilization, this producer must partner with organizations that value specific carbon dioxide sources. Our findings emphasize that capabilities for synergy exploitation through coordination and adaptability within value chains are particularly important when addressing

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systemic sustainability goals (see Alzate *et al.*, 2022). Moreover, the risk management capabilities identified in our study expand the understanding of resiliency capabilities for value chains (Chari *et al.*, 2022).

At the *ecosystem level*, contrary to our expectations, the carbon circulation ecosystem did not showcase a large degree of the strategic agility and sensitivity as found in previous research (Sahasranamam and Soundararajan, 2022), possibly because the commercialization of carbon circulation technologies is recent and partly ongoing in the case ecosystem (Kujanpää *et al.*, 2023). Instead, our findings emphasized the need for an ecosystem to have novel capabilities for systemic knowledge development, system optimization, institutional co-creation and regionality. While knowledge development and collaboration are typical characteristics in the ecosystem literature (Aarikka-Stenroos and Ritala, 2017; Thomas and Autio, 2020), they have rarely been proposed as specific capabilities that an ecosystem could collectively possess. When addressing systemic sustainability goals, we also see that institutional work towards systemic goals (Fehrer and Wieland, 2021), often through collective action (Thomas and Ritala, 2022), requires the entire ecosystem to develop capabilities in shaping policies and regulation as well as attitudes and norms to enhance the legitimacy of the innovations enabling carbon circulation, which we call institutional co-creation capabilities. Meanwhile, regionality capabilities—as conceptualized in this study—resonate with prior understanding of a CE, in which organizations are searching for local synergies through, for example, industrial symbiosis (Uusikartano, Saha and Aarikka-Stenroos, 2022). In the case of carbon circulation, spatial proximity of operations was also found to be a strong driver for the ecosystem to emerge due to complex logistics and material flow management.

Multilevel capability development to achieve systemic sustainability goals

Instead of being distinct and hierarchical, as originally proposed in Figure 1, we find that capabilities partially overlap across the levels and build on each other, as illustrated in the onion-structured framework (Figure 4). As such, we find the lower-level capabilities to function as resources for capability development in the higher levels, as has been proposed for microfoundational organizational resources to build organizational-level capabilities (Amit and Schoemaker, 1993; Teece, 2017). Thus, we claim that organizational-level capabilities serve as microfoundational resources for value chain and ecosystem capabilities, thereby providing a novel approach to microfoundations (Teece, 2007) on a broader scale of the multilevel paradigm in management science (Gupta, Panagiotopoulos and Bowen, 2023).

For capability development (illustrated with arrows on the left in Figure 4), we posit diversity, density and distribution of capabilities within an ecosystem and its value chains as key characteristics that lead to management implications (Aarikka-Stenroos, Ritala and Thomas, 2021). These implications vary from how to manage more dispersed collective action for distributed capabilities (Thomas and Ritala, 2022) to orchestration for more condensed capability distribution (Parida *et al.*, 2019) or a hybrid of the two, which is underexplored in the literature. Firstly, to develop capabilities from the organizational to the value-chain level, our findings highlighted knowledge sharing and value-chain design through orchestrated and dispersed capability development (see arrows in Figure 4). The findings show that orchestration (manifested in value chain 1) appears efficient when the value chain is created around an organization that both vertically integrates value-chain functions and readily possesses a large number of the needed capabilities, such as strategic, risk management and sustainability capabilities. For example, the capabilities of organization 1 to devise a value chain with partners helped to align the whole chain's sustainability and risk management profiles with those of organization 1. In contrast, when the needed capabilities are spread among value chain organizations more evenly, capabilities must be developed in a dispersed manner (manifested in value chain 2), requiring organizations to come together around value chains and across the conventional industry boundaries to address systemic sustainability goals (see, e.g., Oskam, Bossink and de Man, 2021). Secondly, we identified that knowledge-sharing, collaborative sensemaking and institutional co-creation develop ecosystem-level capabilities through a synergetic hybrid of orchestrated and dispersed capability development in the emergent carbon circulation innovation ecosystem. This is an interesting contribution to the literature that suggests that orchestration is typical of emerging innovation ecosystems (Gupta, Panagiotopoulos and Bowen, 2023).

Finally, we observed that the flow of capability development had reciprocal qualities; for example, systemic knowledge development capabilities at the ecosystem level trickle down as increased risk management, market-oriented, and innovation capabilities in organizations. Thus, the capabilities possessed by the chains and ecosystem generally support the engaged organizations in developing their capabilities across organizational and sectoral boundaries.

Conclusion

Our findings outline—particularly for systemic sustainability goals such as net zero via circularity—the emerging need for novel capabilities for operations

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and logistics, policy and risk management (at the organizational level), sustainability management, risk management, synergy exploitation and new business logic (at the value-chain level), and system optimization, systemic knowledge development, institutional co-creation and regionality (at the ecosystem level), answering RQ1. Although they occasionally overlap, these capabilities manifest differently at the three levels and together contribute to addressing systemic sustainability goals with possible reciprocal effects. Answering RQ2, we found that managing capability development involves either orchestrated or dispersed knowledge-sharing and value-chain design (organizational to value-chain level), and a hybrid of orchestrated and dispersed knowledge-sharing, collaborative sensemaking and institutional co-creation (organizational and value-chain to ecosystem levels). These insights have several implications for the theory and practice of management science and its intersection with sustainability.

Theoretical implications

Our first contribution is to capabilities theory in management research. The traditional management literature often focuses on the organizational level of capabilities (Ambrosini, Bowman and Collier, 2009; Easterby-Smith, Lyles and Peteraf, 2009; McKelvie and Davidsson, 2009; Teece, 2007), ignoring the need to understand the ability of entire value chains or ecosystems to combine resources to achieve systemic goals (see Thomas and Autio, 2020; Thomas and Ritala, 2022). We contribute by identifying a broad set of capabilities at the organizational, value-chain and ecosystem levels (Tables 4–6), expanding from the current interest of dynamic capabilities to capabilities more broadly (Teece, 2017). Moreover, by proposing that organizational-level capabilities can be conceptualized as microfoundational resources for building chain and ecosystem-level capabilities within the multilevel capability approach, we integrate the multilevel paradigm of management research (Dagnino, Levanti and Mocciaro Li Destri, 2016; Kozlowski and Klein, 2000) to capabilities theory with novel multilevel insights distinguishing the levels to which each of the potentially overlapping capabilities belongs and the purpose they serve.

The second contribution is that, apart from identifying the capability types at each level, we examined how management can bring these capabilities together for multilevel capability development. We highlighted that capability development is contingent on the diversity, density and allocation of capabilities within value chains and the ecosystem, leading to the need for the orchestrated, dispersed or hybrid management of capability development. Our findings also illustrate that these capability development approaches may harmoniously co-exist in one ecosystem at different levels. These insights contribute to the multilevel paradigm in management science and its neglected bottom-up processes (Kozlowski and Klein, 2000) and offer a fruitful starting point to theorizing how capabilities emerge among ecosystem organizations through complex interactions (Salvato and Vassolo, 2018) and across sectoral boundaries (Oskam, Bossink and de Man, 2021). This adds to the limited understanding of how capabilities are developed (Easterby-Smith, Lyles and Peteraf, 2009; Ethiraj *et al.*, 2005): where they dynamically emerge from and how they are integrated and coordinated through interactions among multiple organizations with different management efforts (Ethiraj *et al.*, 2005; Gupta, Panagiotopoulos and Bowen, 2023). Meanwhile, these findings from multilevel capability development provided insights into managing and scaling emerging innovation ecosystems (Aarikka-Stenroos and Ritala, 2017; Korhonen, 2001; Thomas and Autio, 2020) and the roles of capabilities therein (Linde *et al.*, 2021) by emphasizing the role of value chains as a bridge that manages how key organizational-level capabilities from different sectors are brought together at the innovation ecosystem level.

Thirdly, we are among the first to put forward an extensive set of capabilities for achieving net zero via circularity and show how to manage their development across organizational, value-chain and ecosystem levels. Therefore, we contribute to the intersection of management and sustainability science by empirically exploring how organizations particularly in industries that cannot avoid carbon emissions may address the dual challenge of achieving net zero and co-creating a CE (Hailemariam and Erdiaw-Kwasie, 2023). While expanding our knowledge of capabilities to meet particular sustainability challenges (Arranz *et al.*, 2022; Demirel and Kesidou, 2019; de Arroyabe *et al.*, 2021), these insights contribute to our understanding of managing multiple organizations towards systemic sustainability goals in an emerging innovation ecosystem (see e.g., Aarikka-Stenroos, Ritala and Thomas, 2021; Kaipainen *et al.*, 2023; Patala, Albareda and Halme, 2022) in a scalable way (Sgambaro, Kaipainen and Chiaroni, 2025). Moreover, applying a management and business approach specifically to carbon circulation expands the understanding of its economic value creation and its local business and innovation contexts in multi-organizational settings (Naims, 2020; Naims and Eppinger, 2022).

Implications for managers and policymakers

We provide a broad list of capabilities for *managers* to consider at the organizational level (see Figure 4) and encourage them to acknowledge the systemic nature of sustainability challenges and their role in developing capabilities for value chains and ecosystems that

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address sustainability goals. Piloting innovations for sustainability requires close interaction and efficient communication among emerging value chains to ensure that all capabilities are present and leveraged. Value creation in these value chains and ecosystems requires management of knowledge-sharing, value-chain design, collaborative sensemaking and institutional co-creation (see Figure 4), enabling the development of the capabilities needed to meet regulatory changes and leverage optimal technologies to satisfy dynamically developing demand for novel circular, low-carbon products. The orchestrated capability development at the value-chain level appears efficient, judging by the fact that value chain 1 made faster progress in designing the chain compared to value chain 2. We encourage organizations that can successfully bring products to customers to drive the value chain design to meet net-zero innovations, even when the markets are only emerging and there are inherent risks involved. Overall, the findings and framework improve our understanding of the practical challenges and opportunities of developing capabilities for joint sustainability challenges, thereby helping organizations and policymakers to navigate the transition to net zero via circularity.

Adopting a capabilities lens provides critical insights and advice for *policymakers* on shaping public policy to support economic development (Teece, 2017). The findings on the need for capabilities related to policy-anticipation indicate that work remains to standardize the rules for carbon circulation practices and products, and incentives are needed to change the existing industrial infrastructure to support net zero through funding and taxation measures. Hence, policymakers should actively invest in carbon circulation innovations and infrastructure beyond country boundaries to enable the development of ecosystems for carbon circulation and other net-zero approaches.

Limitations and future research

Despite the research focus on carbon circulation, we assume our findings are largely generalizable to multiple types of sustainability challenges and systemic goals. This study is limited to the national context of Finland, underscoring the need for future research in different institutional and geographical contexts related to building capabilities for net zero via circularity. However, as reducing carbon dioxide emissions is a global necessity, we expect a degree of generalizability beyond the specific geographical context.

Future research avenues involve continued investigation of multilevel capabilities, potentially longitudinally to understand the development of capabilities for sustainability goals over time as ecosystems develop. Here, theoretical lenses such as dynamic capabilities and natural resource-based view could be useful to examine the environmental management practices related to capabilities and their development. It would be particularly interesting to examine the identified reciprocal interaction among capabilities at different levels. While we dealt with the development of capabilities from organizational to value-chain and ecosystem levels, future research could investigate how value-chain and ecosystem-level capabilities feed into the development of organizational capabilities. Scholars could also examine how organizations must manage the (re)defining of their roles in the value chain and innovation ecosystem as a result of developing new capabilities. Finally, the impacts of policy developments on carbon circulation, net-zero solutions and market development require more interdisciplinary research.

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References

Aarikka-Stenroos, L. and P. Ritala (2017). ‘Network management in the era of ecosystems: systematic review and management framework’, *Industrial Marketing Management*, **67**, pp. 23–36.

Aarikka-Stenroos, L., D. Chiaroni, J. Kaipainen and A. Urbinati (2022). ‘Companies’ circular business models enabled by supply chain collaborations: an empirical-based framework, synthesis, and research agenda’beske’, *Industrial Marketing Management*, **105**, pp. 322–339.

Aarikka-Stenroos, L., P. Ritala and L. Thomas (2021). ‘Circular economy ecosystems: a typology, definitions and implications’. In S. Teerikangas (ed), *Handbook of Sustainability Agency*, pp. 260–276. Cheltenham, UK: Edgar Elgar Publishing.

Akinci, C. and E. Sadler-Smith (2019). ‘Collective intuition: implications for improved decision making and organizational learning’, *British Journal of Management*, **30**, pp. 558–577.

Alzate, I., E. Manotas, A. Boada and C. Burbano (2022). ‘Meta-analysis of organizational and supply chain dynamic capabilities: a theoretical-conceptual relationship’, *Problems and Perspectives in Management*, **20**, pp. 335–349.

Ambrosini, V., C. Bowman and N. Collier (2009). ‘Dynamic capabilities: an exploration of how firms renew their resource base’, *British Journal of Management*, **20**, pp. S9–S24.

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Amit, R. and P. J. H. Schoemaker (1993). 'Strategic assets and organizational rent', *Strategic Management Journal*, **14**, pp. 33–46.

Arranz, N., M. F. Arroyabe, J. Li, C. F. A. Arranz and J. C. Fernandez de Arroyabe (2022). 'An integrated view of eco-innovation in the service sector: dynamic capability, cooperation and corporate environmentalism', *Business Strategy and the Environment*, **32** pp. 2882–2895.

Aslam, H., C. Blome., S. Roscoe and T. Azhar (2018). 'Dynamic supply chain capabilities: how market sensing, supply chain agility and adaptability affect supply chain ambidexterity', *International Journal of Operations & Production Management*, **38**, pp. 2266–2285.

Autio, E., S. Nambisan, L. D. W. Thomas and M. Wright (2018). 'Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems', *Strategic Entrepreneurship Journal*, **12**, pp. 72–95.

Bansal, P. (2005). 'Evolving sustainably: a longitudinal study of corporate sustainable development', *Strategic Management Journal*, **26**, pp. 197–218.

Beske, P. (2012). 'Dynamic capabilities and sustainable supply chain management', *International Journal of Physical Distribution & Logistics Management*, **42**, pp. 372–387.

Bocken, N. M. P. and T. H. J. Geradts (2020). 'Barriers and drivers to sustainable business model innovation: organization design and dynamic capabilities', *Long Range Planning*, **53**, art. 101950.

Bouckaert, S., A. F. Pales, C. McGlade, U. Remme, B. Wanner, L. Varro, D. D'Ambrosio and T. Spencer (2021). *Net Zero by 2050: A Roadmap for the Global Energy Sector*. Paris: OECD.

Boyatzis, R. E. (1998). *Transforming Qualitative Information: Thematic Analysis and Code Development*. Thousand Oaks, CA: SAGE.

Chari, A., D. Niedenzu, M. Despeisse, C. G. Machado, J. D. Azevedo, R. Boavida-Dias and B. Johansson (2022). 'Dynamic capabilities for circular manufacturing supply chains—exploring the role of Industry 4.0 and resilience', *Business Strategy and the Environment*, **31**, pp. 2500–2517.

Chauvy, R. and G. De Weireld (2020). "CO2 utilization technologies in Europe: a short review", *Energy Technology*, **8**, art. 2000627.

Dagnino, G. B., G. Levanti and A. Mocciaro Li Destri (2016). 'Structural dynamics and intentional governance in strategic interorganizational network evolution: a multilevel approach', *Organization Studies*, **37**, pp. 349–373.

Demirel, P. and E. Kesidou (2019). 'Sustainability-oriented capabilities for eco-innovation: meeting the regulatory, technology, and market demands', *Business Strategy and the Environment*, **28**, pp. 847–857.

Dubois, A. and L. E. Gadde (2002). 'Systematic combining: an abductive approach to case research', *Journal of Business Research*, **55**, pp. 553–560.

Dutta, S., O. Narasimhan and S. Rajiv (2005). 'Conceptualizing and measuring capabilities: methodology and empirical application', *Strategic Management Journal*, **26**, pp. 277–285.

Easterby-Smith, M., M. A. Lyles and M. A. Peteraf (2009). 'Dynamic capabilities: current debates and future directions', *British Journal of Management*, **20**, pp. 1–8.

Ellen MacArthur Foundation (2019). 'Completing the picture: How the circular economy tackles climate change'. https://www.ellenmacarthurfoundation.org/completing-the-picture

Ethiraj, S. K., P. Kale, M. S. Krishnan and J. V. Singh (2005). 'Where do capabilities come from and how do they matter? A study in the software services industry', *Strategic Management Journal*, **26**, pp. 25–45.

European Commission (2020). 'Climate strategies and targets: 2030 climate & energy framework'. https://ec.europa.eu/clima/policies/strategies/2030_en.

European Commission (2021). 'Sustainable carbon cycles: Communication from the Commission to the European Parliament and the Council (COM(2021) 800 final)'. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0800.

European Commission (2022). 'European green deal'. https://www.ec.europa.eu/clima/eu-action/european-green-deal_en#european-green-deal.

European Environment Agency (EEA) (2024). 'Eco-innovation index in Europe'. https://www.eea.europa.eu/en/analysis/indicators/eco-innovation-index-8th-eap. Accessed 25 Feb, 2025.

EU Net-Zero Industry Act (NZIA) (2024). 'The Net-Zero Industry Act: making the EU the home of clean technologies manufacturing and green jobs'. https://single-market-economy.ec.europa.eu/industry/sustainability/net-zero-industry-act_en. Accesses 25 February 2025.

Farooque, M., A. Zhang, M. Thürer, T. Qu and D. Huisingh (2019). 'Circular supply chain management: a definition and structured literature review', *Journal of Cleaner Production*, **228**, pp. 882–900.

Fehrer, J. A. and H. Wieland (2021). 'A systemic logic for circular business models', *Journal of Business Research*, **125**, pp. 609–620.

de Arroyabe, J. C., N. Arranz, M. Schumann and M. F. Arroyabe (2021). 'The development of CE business models in firms: the role of circular economy capabilities', *Technovation*, **106**, art. 102292.

Geels, F. W. (2018). 'Disruption and low-carbon system transformation: progress and new challenges in socio-technical transitions research and the multi-level perspective', *Energy Research & Social Science*, **37**, pp. 224–231.

George, G., J. Howard-Grenville, A. Joshi and L. Tihanyi (2016). 'Understanding and tackling societal grand challenges through management research', *Academy of Management Journal*, **59**, pp. 1880–1895.

Gioia, D., K. Corley and A. Hamilton (2013). 'Seeking qualitative rigor in inductive research: notes on the Gioia methodology—Dennis A. Gioia, Kevin G. Corley, Aimee L. Hamilton', *Organizational Research Methods*, **16**, pp. 15–31.

Gupta, A., P. Panagiotopoulos and F. Bowen (2023). 'Developing capabilities in smart city ecosystems: a multi-level approach', *Organization Studies*, **44**, pp. 1703–1724.

Hailemariam, A. and M. O. Erdiaw-Kwasie (2023). 'Towards a circular economy: implications for emission reduction and environmental sustainability', *Business Strategy and the Environment*, **32**, pp. 1951–1965.

Harland, C. M. (1996). 'Supply chain management: relationships, chains and networks', *British Journal of Management*, **7**, pp. 63–S80.

Hart, S. L. (1995). 'A natural-resource-based view of the firm', *Academy of Management Review*, **20**, pp. 986–1014

Kaipainen, J. and L. Aarikka-Stenroos (2022). 'How to renew business strategy to achieve sustainability and circularity? A process model of strategic development in incumbent technology companies', *Business Strategy and the Environment*, **31**, pp. 1947–1963.

Kaipainen J., J. Uusikartano, L. Aarikka-Stenroos, L. Harala, J. Alakerttula and E.-L. Pohls (2023). 'Stakeholder engagement in a sustainable circular economy: theoretical, methodological, and practical perspectives'. In J. Kujala, A. Heikkinen and A. Blomberg (eds), *Stakeholder Engagement in a Sustainable Circular Economy: Theoretical and Practical Perspectives*, pp. 193–231. Cham, Switzerland: Palgrave Macmillan.

Khan, O., T. Daddi and F. Iraldo (2020). 'Microfoundations of dynamic capabilities: insights from circular economy business cases', *Business Strategy and the Environment*, **29**, pp. 1479–1493.

Köhler, J., S. D. Sönnichsen and P. Beske-Jansen (2022). 'Towards a collaboration framework for circular economy: the role of dynamic capabilities and open innovation', *Business Strategy and the Environment*, **31**, pp. 2700–2713.

Konietzko, J., N. Bocken and E. J. Hultink (2020). 'A tool to analyze, ideate and develop circular innovation ecosystems', *Sustainability*, **12**, art. 417.

Korhonen, J. (2001). 'Four ecosystem principles for industrial ecology', *Journal of Cleaner Production*, **9**, pp. 253–259.

Kozlowski, S. W. J. and K. J. Klein (2000). 'A multilevel approach to theory and research in organizations: contextual, temporal, and emergent processes'. In K. J. Klein and S. W. J. Kozlowski (eds), *Multilevel Theory, Research and Methods in Organizations: Foundations, Extensions, and New Directions*, pp. 3–90. San Francisco, CA: Jossey-Bass.

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Kujanpää, L., A. Reznichenko, H. Saastamoinen, S. Mäkikouri, S. Soimakallio, O. Tynkkynen, J. Lehtonen, T. Wirtanen, O. Linjala, L. Similä, J. Keränen, E. Salo, J. Elfving and K. Koponen (2023). *Carbon Dioxide Use and Removal: Prospects and Policies*. Helsinki: Prime Minister's Office.

Linde, L., D. Sjödin, V. Parida and J. Wincent (2021). 'Dynamic capabilities for ecosystem orchestration: a capability-based framework for smart city innovation initiatives', *Technological Forecasting and Social Change*, **166**, art. 120614.

Lopes de Sousa Jabbour, A. B., J. V. Rojas Luiz, O. Rojas Luiz, C. J. C. Jabbour, N. O. Ndubisi, J. H. Caldeira de Oliveira and F. H. Junior (2019). 'Circular economy business models and operations management', *Journal of Cleaner Production*, **235**, pp. 1525–1539.

Marrucci, L., F. Iannone, T. Daddi and F. Iraldo (2022). 'Antecedents of absorptive capacity in the development of circular economy business models of small and medium enterprises', *Business Strategy and the Environment*, **31**, pp. 532–544.

McKelvie, A. and P. Davidsson (2009). 'From resource base to dynamic capabilities: an investigation of new firms', *British Journal of Management*, **20**, pp. S63–S80.

Merriam, S. B. and E. J. Tisdell (2015). *Qualitative Research: A Guide to Design and Implementation*. San Francisco, CA: John Wiley & Sons.

Meuer, J., J. Koelbel and V. H. Hoffmann (2020). 'On the nature of corporate sustainability', *Organization & Environment*, **33**, pp. 319–341.

Nacchiero, R., G. F. Massari and I. Giannoccaro (2024). 'Supply chain transformative capabilities and their microfoundations for circular economy transition: a qualitative study in Made in Italy sectors', *Business Strategy and the Environment*, **33**, pp. 8695–8715.

Naims, H. (2020). 'Economic aspirations connected to innovations in carbon capture and utilization value chains', *Journal of Industrial Ecology*, **24**, pp. 1126–1139.

Naims, H. and E. Eppinger (2022). 'Transformation strategies connected to carbon capture and utilization: a cross-sectoral configurational study', *Journal of Cleaner Production*, **351**, art. 131391.

Oskam, I., B. Bossink and A. P. de Man (2021). 'Valuing value in innovation ecosystems: how cross-sector actors overcome tensions in collaborative sustainable business model development', *Business and Society*, **60**, pp. 1059–1091.

Parida, V., T. Burström, I. Visnjic and J. Wincent (2019). 'Orchestrating industrial ecosystem in circular economy: a two-stage transformation model for large manufacturing companies', *Journal of Business Research*, **101**, pp. 715–725.

Patala, S., L. Albareda and M. Halme (2022). 'Polycentric governance of privately owned resources in circular economy systems', *Journal of Management Studies*, **59**, pp. 1563–1596.

Phillips, M. A. and P. Ritala (2019). 'A complex adaptive systems agenda for ecosystem research methodology', *Technological Forecasting and Social Change*, **148**, art. 119739.

Porter, M. E. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York, NY: The Free Press USA.

Saari, U. A., S. Damberg, M. Schneider, L. Aarikka-Stenroos, C. Herstatt, M. Lanz and C. M. Ringle. (2024). 'Capabilities for circular economy innovation: factors leading to product/service innovations in the construction and manufacturing industries', *Journal of Cleaner Production*, **434**, art. 140295.

Sahasranamam, S. and V. Soundararajan (2022). 'Innovation ecosystems: what makes them responsive during emergencies?', *British Journal of Management*, **33**, pp. 369–389.

Sairanen, M., L. Aarikka-Stenroos and J. Kaipainen (2024). 'Customer-perceived value in the circular economy: a multidimensional framework', *Industrial Marketing Management*, **117**, pp. 321–343.

Sairanen, M. and L. Aarikka-Stenroos (2024). 'Low-carbon business models: review and typology', *Industrial Marketing Management*, **123**, pp. 222–250.

Salvato, C. and R. Vassolo (2018). 'The sources of dynamism in dynamic capabilities', *Strategic Management Journal*, **39**, pp. 1728–1752.

Santa-Maria, T., W. J. V. Vermeulen and R. J. Baumgartner (2021). 'How do incumbent firms innovate their business models for the circular economy? Identifying micro-foundations of dynamic capabilities', *Business Strategy and the Environment*, **31**, pp. 1308–1333.

Scarpellini, S., L. M. Marín-Vinuesa, A. Aranda-Usón and P. Portillo-Tarragona (2020). 'Dynamic capabilities and environmental accounting for the circular economy in businesses', *Sustainability Accounting, Management and Policy Journal*, **11**, pp. 1129–1158.

Shaw, D., A. Cumbers, R. McMaster and J. Crossan (2018). 'Scaling up community action for tackling climate change', *British Journal of Management*, **29**, pp. 266–278.

Shrivastava, P. and H. I. Scott (1992). 'Corporate self-greenewal: strategic responses to environmentalism', *Business Strategy and the Environment*, **1**, pp. 9–21.

Sgambaro, L., J. Kaipainen and D. Chiaroni (2025). 'Scaling up circular ecosystems through product design practices: an integrative framework', *Computers & Industrial Engineering*, **204**, art. 111073.

Stokke, R., F. S. Kristoffersen, M. Stamland, E. Holmen, H. Hamdan and L. De Boer (2022). 'The role of green public procurement in enabling low-carbon cement with CCS: an innovation ecosystem perspective', *Journal of Cleaner Production*, **363**, art. 132451.

Suchek, N., C. I. Fernandes, S. Kraus, M. Filser and H. Sjögrén (2021). 'Innovation and the circular economy: a systematic literature review', *Business Strategy and the Environment*, **30**, pp. 3686–3702.

Teece, D. J. (2007). 'Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance', *Strategic Management Journal*, **28**, pp. 1319–1350.

Teece, D. J. (2017). 'Towards a capability theory of (innovating) firms: implications for management and policy', *Cambridge Journal of Economics*, **41**, pp. 693–720.

Thomas, L. D. W. and E. Autio (2020). 'Innovation ecosystems in management: an organizing typology'. In *Oxford Research Encyclopedia of Business and Management*. Oxford University Press.

Thomas, L. D. W. and P. Ritala (2022). 'Ecosystem legitimacy emergence: a collective action view', *Journal of Management*, **48**, pp. 515–541.

United Nations (2015). 'The Paris Agreement'. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

Uusikartano, J., P. Saha and L. Aarikka-Stenroos (2022). 'The industrial symbiosis process as an interplay of public and private agency: comparing two cases', *Journal of Cleaner Production*, **344**, art. 130996.

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