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# Companies' circular business models enabled by supply chain collaborations: An empirical-based framework, synthesis, and research agenda

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ABSTRACT

The circular economy (CE) has been lauded as a path enabling more environmentally sustainable economic growth for diverse industrial companies, requiring them to design and implement circular business models (CBMs). A CE widens a company's perspective to include supply chains when adopting and implementing a CBM; however, the intersection of CBMs and circular supply chain management (CSCM) research has been understudied. Although considerable CBM research has been carried out, the role of supply chain collaboration in companies' CBMs has been neglected. To address this research gap, in the present study we integrate knowledge from CBM and CSCM literature and conduct a qualitative multiple case study of six Italian and Finnish companies in order to analyze how their supply chain collaborations enable implementation of CBMs. The results allow us to develop a new conceptual framework, a synthesis of how supply chain collaborations support companies' CBM design and implementation, and a research agenda comprising seven thematic management aspects at micro, meso, and macro-levels. The framework, synthesis, and agenda provide conceptual guidance and structure for researchers and pragmatic guidance for managers.

## 1. Introduction

The circular economy (CE) has been recognized as a path enabling more environmentally sustainable economic growth (Kirchherr, Reike, & Hekkert, 2017). It represents a new industrial approach aimed at disrupting the dominant linear "take, make, dispose" economic paradigm of production and resource consumption (Ghisellini, Cialani, & Ulgiati, 2016) by introducing sustainable models of regenerative design, "cradle-to-cradle" principles, industrial ecology, and clean production. Thus, it aims to create a restorative industrial system that is sustainable by design (Geissdoerfer, Morioka, de Carvalho, & Evans, 2018). For many industrial companies, increased circularity implies the redesign of technologies, products, services, operations, and business models (Ranta, Aarikka-Stenroos, & Mäkinen, 2018), often requiring the focal company to collaborate with others in order to enable and implement such circular redesign of their businesses.

As the shift from a linear to a circular approach is a system change, it requires circular shift and redesign to happen on different levels, from single companies and organizations (micro-level), to organizational collaborations and supply chains (meso-level), and further to regional and national developments (macro-level) (Khitous, Strozzi, Urbinati, & Alberti, 2020; Ranta et al., 2018; Ünal, Urbinati, Chiaroni and Manzini, 2019). Research, thus far, has provided rapidly increasing understanding on how single companies, at micro-level, can adopt and implement circularity via circular business models (CBMs), managerial practices, and value creation logics (Lüdeke-Freund, Gold, & Bocken, 2019; Ranta, Keränen, & Aarikka-Stenroos, 2020; Tura et al., 2018; Urbinati, Chiaroni, & Toletti, 2019). At the macro and meso-levels, it has largely focused on how industries or sectors adopt and implement sustainability or circularity (Merli, Preziosi, & Acampora, 2017) and only rarely and

*Abbreviations:* CBM, Circular Business Model; CSC, Circular Supply Chain; BM, Business Model; SC, Supply Chain; CE, Circular Economy; B2B, Business-to-Business; CSCM, Circular Supply Chain Management; PSS, Product-Service System; REM, Resource efficiency measure; LCA, Life Cycle Assessment; RTA, Ready-To-Assemble; R&D, Research and Development; CEO, Chief Executive Officer.

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recently it has studied how inter-organizational collaborations enable implementation of circularity (Ingstrup, Aarikka-Stenroos, & Adlin, 2021). Although considerable CBM research has been carried out among start-ups and larger companies, CE business research lacks understanding of how particularly industrial-scale companies' CBMs are enabled by supply chain collaborations. This understanding is crucial, as the CE principles (i.e., recycling, reuse, and reduction) necessitate, for example, closing material and product loops (Geissdoerfer et al., 2018) and therefore implies changes in companies' relationships, collaborations, and, in particular, supply chains (Kaipainen & Aarikka-Stenroos, 2021; Kaipainen & Aarikka-Stenroos, 2022).

Circularity, realized via supply chains, is the focus of circular supply chain management (CSCM) (Geissdoerfer et al., 2018; Zhang & Watson IV, 2020), addressing circular flow, and emergence and re-emergence of value, from materials and resources in the supply chain (Haneef et al., 2016). Thus, circular supply chain (CSC) literature suggests that value can emerge from, for example, leasing and service outcomes instead of ownership, and that value can be created via closed, short, and cascading loops rather than partially closed ones. Collaborative and collective value is captured, and customer effectiveness is less important. Furthermore, the scope of CSC is local, not global, and reuse, refurbishment, and cascading extend use repair and recycling activities (De Angelis, Howard, & Miemczyk, 2018). Surprisingly, although supply chains are recognized as key to CE implementation (Geissdoerfer et al., 2018; Hazen, Russo, Confente, & Pellathy, 2020), and studying them is urgent and has critical impact (Farooque, Zhang, Thürer, Qu, & Huisingh, 2019), CSC research is still in its infancy and takes the form of conceptual syntheses; empirical investigations are lacking (Bressanelli, Pigosso, Saccani, & Perona, 2021; Geissdoerfer et al., 2018; Lahane, Kant, & Shankar, 2020; Masi, Day, & Godsell, 2017). There is, however, a consensus on the need for empirical case studies and examples of successful implementations of CSC (De Angelis et al., 2018; Ferasso, Beliaeva, Kraus, Clauss, & Ribeiro-Soriano, 2020; Govindan & Hasanagic, 2018; Hazen et al., 2020; Ranta et al., 2020; Sehnem, Vazquez-Brust, Pereira, & Campos, 2019).

To summarize the extant research gaps, CBM and CE business research provide company centric understanding on companies' CBMs and value creation but lacks understanding of what the role of supply chain collaborations is in enabling this, particularly when doing business from industrial-scale physical circular resource flows. CSCs provide understanding on how value can be created from circularity in chains but does not provide empirical evidence on what this implies for single companies with industrial scale business. Emerging 'B2B' and industrial business research examining circularity has studied start-ups (Närvänen, Mattila, & Mesiranta, 2021) and industry-academia collaborations for the CE (Ingstrup et al., 2021) and, therefore, has not studied this important aspect either.

In the present study, therefore, our aim is to bridge the gap between the CBM and CSCM literature streams by extending the perspective from a company focus (micro-level) to the more relational inter-organizational collaborations and supply chains (meso and macro-levels) (De Angelis et al., 2018; González-Sánchez, Settembre-Blundo, Ferrari, & García-Muiña, 2020; Masi et al., 2017). This approach allows us to develop a new understanding on how industrial companies can implement their CBMs via their supply chains collaborations. To achieve this, we emphasize not only the perspective of a company and its CBM, but also place supply chain collaborations at the center of a new CBM framework. Thus, we follow the so-called "portfolio" approach of managing business relationships developed by Ritter, Wilkinson, and Johnston (2004), meaning that a company needs to develop and manage its collaborative relationships with customers, suppliers, complementors, and competitors, because they directly and indirectly affect a company's business' performance. Following this "portfolio" approach, we look at collaborations from a company perspective, to be managed. By following definitions for CE oriented collaborations, by Mishra, Hopkinson, and Tidridge (2018) and González-Sánchez et al. (2020), in this paper, we consider collaborations as joint activities between the company and the other actors for circularity and examine supply chain collaborations that enable a company's CBM design and implementation. Collaborations within a supply chain for a CBM can concern upstream and downstream supply chain actors, including, for example, suppliers' engagement, training, selection, and environmental collaboration with customers (Bressanelli, Perona, & Saccani, 2019; Ferasso et al., 2020; Hussain & Malik, 2020), and can pursue superior environmental and economic performance (Farooque et al., 2019).

To reach our research aim, we pose the following research questions: *"When industrial companies design and implement a CBM, how is this reflected in their supply chain collaborations?"* and *"How do such collaborations support companies in the design and implementation of their CBMs?"* Answering these questions adds to theory, but is also pragmatically important, as it generates new understanding of how industrial scale companies can increase circularity and sustainability via business model (re)design and supply chain collaborations, and it advises managers on how to improve both company-level and collaborative operations.

We take a theory-development approach and start by merging existing knowledge from the two research fields to build a new framework for CBM design and CSC collaborations. This framework then provides a structure for an empirical exploration of how industrial companies' CBM design and implementation is enabled via supply chain collaborations. In the empirical part, we conduct a qualitative multiple case study of six Italian and Finnish industrial companies to identify and conceptualize generalizable patterns across regional and industrial contexts, and to develop a more polished model and synthesis, which explain how supply chain collaborations support industrial companies in CBM design and implementation. We also develop a structured research agenda to encourage future scholars to study further this important, still developing area. The framework, synthesis, and agenda offer practical guidance for managers who may otherwise struggle to put CE principles into practice.

The present study is structured as follows: Section 2 provides the current state of research in the fields of CBMs and CSCM and thus builds a theoretical framework for CBM practices and CSC collaborations. Section 3 provides the rationale for the methodology in terms of research design, data gathering, analysis, and evaluation. Section 4 presents the case studies. Section 5 summarizes the results and proposes a final framework/model. Section 6 discusses the results and synthesizes how collaborations support companies' CBM design and implementation and what, therefore, needs to be managed. And finally, Section 7 concludes with theoretical contributions, a structured research agenda for future research, and managerial implications.

## 2. Theoretical background and conceptual development

### 2.1. Circular business model (CBM) research

CBM research emerged from the CE domain with the aim of investigating business strategy at the micro-level, taking the company as the unit of analysis (Bocken, De Pauw, Bakker, & Van Der Grinten, 2016; Ranta et al., 2018). Accordingly, companies willing to adopt CE are encouraged to adopt specific managerial practices in their CBMs in order to create, transfer, and capture value in a circular fashion (Linder & Williander, 2017). Managerial practices represent the actions that top managers can implement in the business model of the companies in which they operate to ensure such companies move toward adoption of a CBM (Ünal, Urbinati, & Chiaroni, 2019). For example, value is *created* when Design for X practices are adopted in product production and process redesign (Sassanelli, Urbinati, Rosa, Chiaroni, & Terzi, 2020). These design practices may entail remanufacturing and reuse, or the restructuring of relationships with suppliers, manufacturers, and retailers (Vermeulen, 2015). Value is *transferred* by leveraging new modes of communication with clients to promote a company's value proposition, which includes the use of multi-channel communication (Urbinati,

**Table 1**
Managerial practices for CBM design (adapted from Franzò et al., 2021).

| Business model dimensions | Value creation | Value transfer | Value capture |
|---|---|---|---|
| Managerial practices | - Design for X practices<br>- Resource efficiency measures (REMs) or practices on the supply side, demand side, and life cycle to reduce the resources needed for goods or services, redesign of processes, life cycle assessment (LCA) techniques<br>- Selection of partners along the supply chain and development of a suitable ecosystem of several stakeholders<br>- Energy efficiency and use of renewable energy sources<br>- Exploitation of waste as a resource | - Commercial and promotion initiatives<br>- Communication of circularity through all channels<br>- Offering the right value to the right customers<br>- Management of changes in customer habits (or even changes in customers) due to selling circular products or services | - Shift from product selling to the product-service system (PSS)<br>- Extension of the product life cycle through collaborative consumption and virtualization of services<br>- Building and maintenance of relationships with customers (to achieve waste elimination and closing loops; e.g., incentives and benefits offered to customers for taking back used products) |
| Main references | Marconi, Germani, Mandolini, & Favi, 2019; Mendoza, Sharmina, Gallego-Schmid, Heyes, & Azapagic, 2017; Sassanelli et al., 2020; Scheepens, Vogtl, & Brezet, 2015; Gilbert, Wilson, Walsh, & Hodgson, 2017; Diaz Lopez, Bastein, & Tukker, 2018; Urbinati et al., 2017; Niero & Hauschild, 2017; Smieja & Babcock, 2017; Moreno, Court, Wright, & Charnley, 2018; Lacy & Rutqvist, 2016; Esposito, Tse, & Soufani, 2018 | Centobelli, Cerchione, Chiaroni, Del Vecchio, & Urbinati, 2020; Geissdoerfer et al., 2018; Kirchherr et al., 2017; Urbinati et al., 2017; Evans, Gregory, Ryan, Bergendahl, & Tan, 2009; Bocken, Short, Rana, & Evans, 2014; Baxendale, Macdonald, & Wilson, 2015; Pomponi & Moncaster, 2016; Lieder, Asif, & Rashid, 2017; Shao & Ünal, 2019 | Tukker, 2015; Reim, Parida, & Ortqvist, 2014; Witjes & Lozano, 2016; Rosa, Sassanelli, Urbinati, Chiaroni, & Terzi, 2020; Urbinati et al., 2017; Lacy & Rutqvist, 2016; Singh & Ordoñez, 2016; Ranta et al., 2018 |

Chiaroni, & Chiesa, 2017) and platform-sharing (Kirchherr et al., 2017). Value is *captured* by managing customer relationships and implementing product-service systems (PSSs) with pay-per-use or pay-per-performance service models (Tukker, 2015; Tukker & Tischner, 2006). Use-oriented PSSs are especially aimed to maintain the product as central in the offer, but the product remains under the ownership of the producer (e.g., pay-per-use), while result-oriented PSSs are particularly aimed at allowing the producer to sell results rather than products (e.g., pay-per-performance) (Khitous, Urbinati, & Verleye, 2022).

Table 1 shows the most relevant studies in the field of CBMs, highlighting particular managerial practices which support CBM design, as informed by the recent contribution of Franzò, Urbinati, Chiaroni, and Chiesa (2021). These practices can be implemented by, or benefit from, collaboration with actors in the supply chain.

The effective implementation of the practices shown in Table 1 requires upstream (supplier, manufacturer, and retailer) and downstream (customer) collaborations. Building on Zucchella and Previtali (2019)'s study, we argue that the transition to CE, and, in particular, to CBMs, is more valuable if the views of individual companies align with those of actors in the system concerning their understanding of "how the system is orchestrated, how value is created, and how the system can grow and expand" (p. 276). This implies that a network of actors operating symbiotically in the supply chain is crucial to CBM design and implementation. Therefore, we take stock of the studies reviewed in Table 1 and explore the collaboration opportunities made available to actors in CSCs by designing and implementing a CE in a company's business model.

### *2.2. Collaborations for circular supply chains (CSCs)*

CBM implementation challenges companies to rethink their value creation, transfer, and capture beyond organizational boundaries, and thus create CSCs (De Angelis et al., 2018; Geissdoerfer et al., 2018; Lüdeke-Freund et al., 2019). CSCs allow managing the flows of products, by-products, and waste in supply chains and their surrounding industrial and natural ecosystems through CE principles (Farooque et al., 2019). This separates them from other similar concepts, such as green supply chains, sustainable supply chains, reverse logistics, closed-loop supply chains, and industrial symbiosis.

CSCs demand novel collaboration across the upstream and downstream supply chains (Masi et al., 2017; Zhu, Sarkis, & Lai, 2008) beyond sector boundaries, extending to institutional, governmental, and societal actors for development of functioning regulatory, fiscal, and cultural environments and applications of smart technologies (González-Sánchez et al., 2020; Govindan & Hasanagic, 2018). Collaboration allows implementing three widely recognized circular strategies: (i) the closing strategy, which comprises recycling measures and is aimed at closing the loop between post-use and production; (ii) the slowing strategy, which intensifies the product use period through the design of long-life goods and product-life extension (i.e., service loops to extend a product's life, for example, through repair or remanufacturing), resulting in a slowdown in the flow of resources; and (iii) the narrowing strategy, which improves resource efficiency by using fewer resources per product (Bocken et al., 2016).

It is critical to extend understanding from general stakeholder mappings to the versatile collaborations between supply chain actors (Bressanelli et al., 2021; Ferasso et al., 2020) for real-life implementation of CSCM strategies, particularly on the more neglected slowing and closing strategies (Bressanelli et al., 2021) and from the industrial business perspective. Table 2 shows that the extant understanding on how to collaborate for implementing CSCM strategies (i.e., closing, slowing, and narrowing) is fragmented across several research streams (Geissdoerfer et al., 2018; Lahane et al., 2020; Masi et al., 2017): production and manufacturing; supply chain and operations; and CE and sustainability. Meanwhile, understanding from the 'B2B' and industrial business perspective is limited to implicitly, assuming SC collaborations in industrial CE implementation.

### *2.3. A theoretical framework for studying a company's CBM practices and CSC collaborations*

In this section, we piece together insights from CBM and CSCM literature streams: CBMs focus on companies' micro-level practices to generate value from circularity (i.e., value creation, value transfer, and

**Table 2**
Collaborations for implementing CSCM strategies as discussed in related and relevant research streams.

| | *Production and manufacturing research* Growing discussion focusing principally on the supply chain perspective | *Supply chain, operations, and logistics management research* Narrow stream taking the perspective of SC and various SC actors to investigate CE implementation | *Sustainability and CE research* Stream considering CSCM as part of CBM and/or as an enabler of different sustainability dimensions | *Industrial business and B2B research* Stream examining industrial businesses' circularity (BM, supply chain) |
|---|---|---|---|---|
| Collaborations for implementing CSCM strategies | - Collaboration for reverse logistics, closed-loop supply chains, and take-back incentives, emphasizing regional/local loops *(Closing, narrowing)*<br>- Collaborative (re)designing of products with CE principles, and identification of components, exclusion of toxic materials, and improved after-use collection *(Closing, slowing)*<br>- Controlling material flows between supply chain collaborators by integrating tech/digitalization into processes *(Closing, slowing, narrowing)*<br>- Collaborating to lease, rent, and share with servitizing revenue models *(Slowing, narrowing)*<br>- Developing partnerships and trust among different supply chain actors; engaging new actors in multi-actor supply networks, across competing SCs and between industrial sectors *(Closing, slowing, narrowing)* | - Collaboration for reverse logistics and closed-loop supply chains (*Closing, narrowing*)<br>- Extending collaboration to develop suppliers' capabilities in improving CE initiatives across the supply chain *(Closing, slowing, narrowing)*<br>- Collaborative (re)designing products with CE principles *(Closing, slowing)*<br>- Collaborating to lease and utilize services, enabled by digital systems *(Slowing, narrowing)*<br>- Engaging multi-actor supply network in collaboration and reducing waste in all production stages, including integration and coordination between logistics partners and customers interested in decarbonizing logistics *(Narrowing)* | - Collaboration for reverse logistics, closed-loop supply chains, and industrial symbiosis *(Closing, narrowing)*<br>- Collaboration on product development that applies long-life modeling and Design for X (e.g., design for durability and life extension) (*Closing, slowing*)<br>- Collaborating for product-service system BMs and sharing, leasing, and renting services, enabled by utilization of digital technologies *(Slowing, narrowing)*<br>- Developing collaborations with customers with CE goals, utilizing various communication practices and knowledge sharing along the supply chain to ensure greater intensity in the relationships, and agreeing on the distribution of profits to coordinate the system under a fixed risk-sharing degree *(Closing, slowing, narrowing)*<br>- Selecting the correct suppliers, building relationship capacity, and developing close collaborations with them for efficient and shared management of resources and decrease of waste in all production stages *(Narrowing)*<br>- Collaborating to lease and utilize services, enabled by digital systems *(Slowing, Narrowing)* | - Communicating economic and environmental benefits to supply chain collaborators by preparing value propositions through resurrecting value logics *(Closing)*<br>- Inclusion and information flow in collaboration among all supply chain partners, from design and raw material suppliers to end users, service providers, and recyclers *(Closing, slowing, narrowing)*<br>- Implementing well-defined contract models that ensure the coordination of the circular supply chain collaborations *(Narrowing)*<br>- Collaborating for product-service system BMs *(Slowing, narrowing)* |
| Main references | Govindan & Hasanagic, 2018; Bressanelli et al., 2019; De Angelis et al., 2018; Mishra et al., 2018; Mangla et al., 2018; Yang, Smart, Kumar, Jolly, & Evans, 2018; Vlajic, Mijailovic, & Bogdanova, 2018; de Sousa Jabbour, Jabbour, Godinho Filho, & Roubaud, 2018 | Hazen et al., 2020; Sehnem et al., 2019; Liu, Feng, Zhu, & Sarkis, 2018; Guide & Van Wassenhove, 2009 | Farooque et al., 2019; Lahane et al., 2020; Geissdoerfer et al., 2018; Bressanelli et al., 2021; Lapko, Trianni, Nuur, & Masi, 2019; González-Sánchez et al., 2020; Masi et al., 2017; Maranesi & De Giovanni, 2020; Lüdeke-Freund et al., 2019; Julianelli, Caiado, Scavarda, & de Cruz, 2020 | Fehrer & Wieland, 2020; Ranta et al., 2020 |

value capture), and CSCM focuses on meso-level collaborations to implement circular strategies (i.e., closing, slowing, and narrowing resource loops). We associate each CBM dimension with a specific CSCM strategy to propose a theoretical framework of CBM practices and CSC collaborations. Then, we discuss the connection between CBM practices and CSC collaborations in more detail.

To attain a closing strategy, companies can activate a set of managerial practices related to reverse and closed-loop logistics (Guide & Van Wassenhove, 2009; Julianelli et al., 2020; Lapko et al., 2019). In this case, companies may collaborate for closed-loop production or to take back materials and resources in closing the loop between post-use and production (Corvellec & Stål, 2019; Sehnem et al., 2019). To achieve a slowing strategy and extend the product life cycle, companies can apply service-oriented thinking to their business models (Hazen et al., 2020) and activate redesign practices for materials and resources within a product (Bressanelli et al., 2021; De Angelis et al., 2018; Sassanelli et al., 2020). Accordingly, companies collaborate for Design for X practices, pay-per-use systems (Bressanelli et al., 2021; Kjaer, Pigosso, Niero, Bech, & McAloone, 2019), supplier exploitation, customer engagement, and stakeholder communications to identify and collect residual products and maximize their utilization (Berg & Wilts, 2018; De Angelis et al., 2018). And finally, to achieve a narrowing strategy focused on energy and material resource efficiency objectives, companies can implement collaborative policies or service models with pay-per-performance systems (Bressanelli et al., 2021; Diaz Lopez et al., 2018). Therefore, multiple points of engagement or communication should be exploited by companies to exchange resources at the height of their life cycle and reduce their environmental impact (De Angelis et al., 2018; Schwanholz & Leipold, 2020).

The proposed framework, therefore, maps key managerial practices that can be implemented in CBMs, catalyzed by (circular) supply chain collaborations to achieve CSCM strategies (Fig. 1), and is used as a

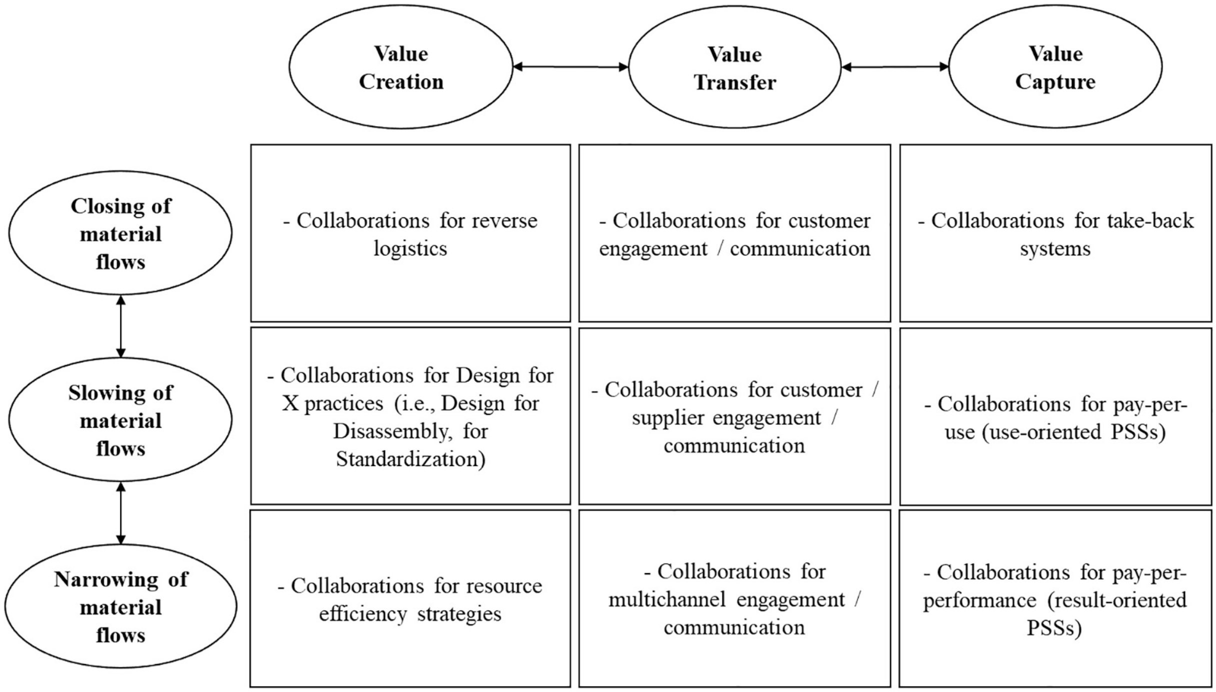


**Fig. 1.** Theoretical framework for CBM practices and CSC collaborations.

theoretical structure for the following empirical study.

## 3. Methodology

### *3.1. Research design and multiple case study*

As little empirical research has been conducted on how companies (particularly industrial scale) can implement CBMs via their supply chains collaborations. (De Angelis et al., 2018; Ferasso et al., 2020; Govindan & Hasanagic, 2018; Hazen et al., 2020; Sehnem et al., 2019), we apply a qualitative research design and a multiple case study strategy to explore the phenomenon empirically. A multiple case strategy with a moderate number of industrial company cases allows us firstly to examine each case deeply enough in order to understand its characteristics within the supply chain and the contexts of its collaboration, including industrial and regional settings; and secondly to compare cases over industrial and regional contexts in order to identify and theorize more generalizable patterns (Beverland & Lindgreen, 2007; Eisenhardt, 1989). We selected six companies from two European locations, Italy and Finland (three from each), with similar characteristics: (i) all the companies had a circular industrial-scale business in either process manufacturing (material processing and reprocessing) or product and project business; and (ii) all had made circularity-related changes to their business and had successfully and profitably established a CBM as demonstrated by, for example, attaining a market leader position. As circular business can take various company business model forms, shaping also needed collaborations (Ranta et al., 2020), we have acknowledged this variation by using a variation principle (Patton, 2005) within our sampling to improve the transferability of our findings. The process manufacturing cases (A, B, and E) concern forest, oil, and textile industries, whereas the product/project cases (C, D, and F) concern construction, furniture, food, and beverages. The multiple case settings allow us to develop theory, via a structured analysis of several examples and via cross-industry and cross-regional comparisons, unmasking general patterns of how circularity and related business model development shape companies' supply chain collaborations. Therefore, we aim to provide an analytical and conceptual, rather than a statistical, generalization.

All the selected companies are headquartered in Europe and conduct business globally. The companies were identified from CE research projects carried out by the researchers, which allowed us to form a pre-understanding of each company and develop trustful links with the management of each. Therefore, dynamic, meaningful, and even confidential data on business development could be acquired and analyzed. This pre-understanding also enabled us to apply a theoretical sampling principle in our study (Flick, 2004; Patton, 2005); that is, since the selected cases supplied information relevant to our research focus as they had made circularity-related changes in their supply chains, we were able to refine the emerging theoretical categories of CBM development through supply chain collaborations. Following a "portfolio" approach (Ritter et al., 2004), the case 'unit' was determined to be an industrial company that had implemented a CBM in which supply chain collaborations played a key role, and each of the company's collaborations at the meso and macro-levels formed the case boundaries. We primarily captured the companies' perspectives as we focused on their CBMs and related supply chain collaborations. Background information and data gathered for each case are shown in Table 3.

### *3.2. Data gathering, analysis, and evaluation*

Our analysis uses primary data from company interviews and secondary sources, as described in Table 3, to develop rich insights (Eisenhardt, 1989). Thematic, in-depth interviews were conducted from 2019 to 2021, both face-to-face and online, with company representatives including CEOs, managers, and leading experts, who explained the technical and business operations of each company, circularity within them, and related supply chain collaborations. For each case, between two and 13 respondents were interviewed. Between two and four main interviews formed the basis understanding per case, and supplementary interviews provided even more depth and triangulation in some cases. The interviews addressed the following themes: (1) how circularity is shown in the business (e.g., in technology enabling industrial-scale circular business and in business operations realizing the CBM, i.e., value creation, value transfer, and value capture); (2) how the company's business and business model are developed and developing toward circularity and the role of collaborations in this process (e.g.,

**Table 3**
Cases and data sources.

| Company and industry | Company size (Revenue) (million euro [MEUR]) | The core industrial business and the role of supply chain | Primary and secondary data |
|---|---|---|---|
| Case A (Finland) Process manufacturing; forest industry | 9,800 MEUR | Produces wood-based products, such as paper, pulp, wood-plastic composites, and paper-based labels. Reverse logistics for label waste | Three interviews conducted 2019–2021 (Service Director, Vice President of Biomass Business Unit, Director of Feedstock Operations) Secondary data: Company reports, news, and press releases |
| Case B (Finland) Process manufacturing; oil refinery and technology development | 14,900 MEUR | Produces, refines, and markets oil products and provides engineering services and licensing production technologies. Diversified supply chains for renewable fuel products | Four main interviews (Senior Vice President of Sustainability and Public Affairs, Vice President of Research and Technology, Head of New Feedstock, Key Account Manager of Nordic Region) and six supplementary interviews, conducted 2019–2021 Secondary data: Company reports, news, press releases, and interactive lectures |
| Case C (Finland) Product and project business; construction | >3,000 MEUR | A construction company operating broadly in the fields of buildings and infrastructure. Construction projects require collaboration and coordination with a variety of suppliers, leading increasingly to reusing soil materials within and between construction projects | Three main interviews (Retired Head of Environmental Affairs in Infrastructure Construction, Development Engineer, Project Engineer) and 10 supplementary interviews with Project Managers, conducted 2020–2021 Secondary data: Company reports, news, and press releases |
| Case D (Italy) Product and project business; coffee & food | > 3,000 MEUR | Produces and distributes the coffee cups of a well-established brand. Supply chain includes aluminum and other materials for the cups and coffee for the content. Reverse logistics for used cups | Three interviews conducted 2019–2020 (Managing Director, Head of Sustainability, Head of Marketing) and five supplementary interviews with the members of the sustainability team, conducted 2019–2021 Secondary data: Company reports, videos, news, and press releases |
| Case E (Italy) Process manufacturing; textiles | > 20 MEUR | A diversified textile producer working in different fields (textiles for clothes, fabrics for furniture, etc.). The company produces high-end fabric with recycled fabrics from acrylic curtains | Two main interviews (Head of Marketing, Head of R&D) and three supplementary interviews with R&D employees involved in the development phase, conducted 2019–2021 Secondary data: Project website, company reports, news, and press releases |
| Case F (Italy) Product and project business; furniture | > 100 MEUR | The company produces and sells ready-to-assemble (RTA) furniture designed to combine beauty and functionality with industrial production and environmentally sustainable development. All furniture is made with ecological particleboard panels, 100% recycled wood, made using a process with low environmental impact | Three main interviews (CEO, Head of Marketing, Head of R&D) and two supplementary interviews with members of the marketing team, conducted 2020–2021 Secondary data: Company website, company reports, news, and press releases |

business model development and redesign and related changes in collaborations); (3) the key partners and stakeholders enabling circularity in industrial business and the rationale for their role; and (4) the focus of the company's future plans and directions, and further collaborations needed due to circularity; and challenges, perceptions, and expectations for the changes that will occur to the business landscape due to increased circularity requirements (e.g., industry norms and regulation of circularity) at the company/micro-level and wider meso and macro-levels. Interviews typically lasted 45–90 min and were recorded and transcribed. Field memos were written during the interviews, which were complemented by prior and follow-up telephone discussions and e-mail correspondence.

In all cases, secondary data included internal and media-originated data, such as technical documents, annual reports, companies' marketing materials and marketing brochures, newspaper articles, and companies' websites and other webpages concerning their products, solutions and offerings, businesses, evolving market and business environments, and collaborations. This data provided details on the focus of the company's circular business, business model aspects, and related collaborations.

To analyze the data and theorize from the cases, we followed an abductive reasoning process that is particularly useful for developing theory and can start either with tight and pre-structured or loose and

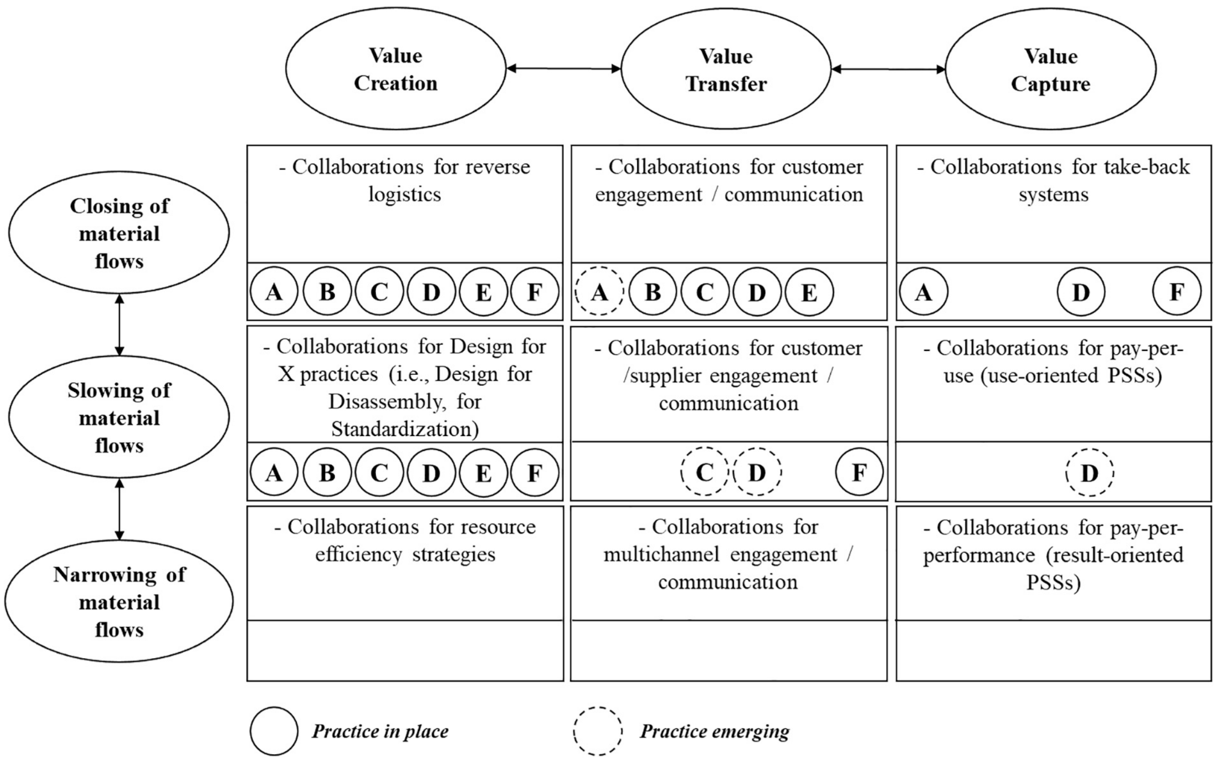


**Fig. 2.** Case companies and related implementation of CBM practices and CSC collaborations mapped onto the dimensions of the theoretical framework.

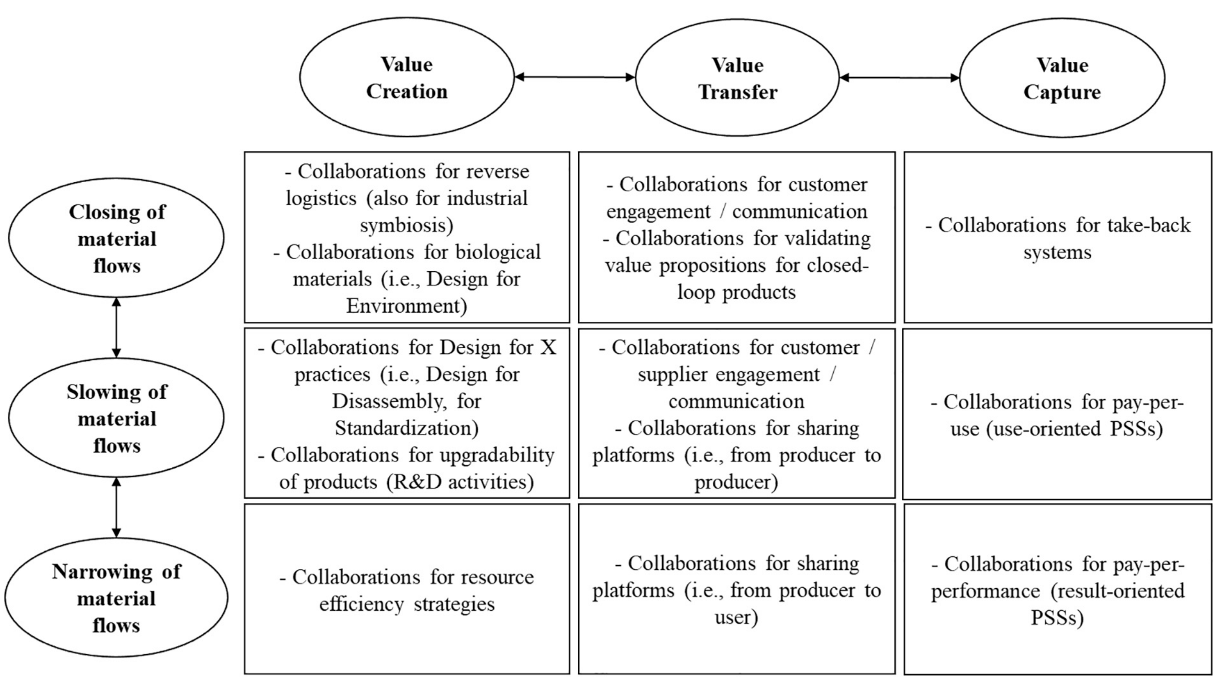


**Fig. 3.** Final framework for CBM practices and CSC collaborations.

emergent frameworks in order to enhance theorization (Andersen & Kragh, 2010; Dubois & Gadde, 2002; Reichertz, 2004). Concerning this research, we began with a simplified loose framework (Fig. 1) and theoretical mapping (Tables 1, and 2), which offered initial theoretical support and an analytical structure to identify and analyze CBM dimensions and collaborations with different supply chain actors and other stakeholders from empirical cases, in a somewhat deductive manner. Some findings were identified in a more data-driven thematic analysis, in an inductive manner. Through iterative analysis rounds, we developed the final model (Fig. 2) and synthesis (Table 5) that show the analyzed themes.

As an example, on thematic analysis and conceptual mapping, a Case A interviewee commented, *"We are eager to collect that waste, and they do not have to pay for its treatment, as it is a useful raw material for us"* (Head of Strategic Partnerships). This statement was interpreted to help explain the value-capture dimension of CBMs. In Case D, an interviewee stated, *"We had to convince our dealers and final shops to work more closely with us, and we had to re-negotiate all the contracts with the logistic providers to make this possible"* (Member of the Sustainability Team). This was interpreted to reflect the need for collaborations with supply chain actors. Collaborations with dealers and final shops have been classified, based on their goal, as belonging to customer engagement/ communication, whereas those with logistic providers are interpreted as supporting the reverse logistics process.

The analysis began with a *within-case* analysis that resulted in an overview of each company's CBM dimensions and the role of collaboration. In the subsequent *cross-case* analysis, we compared cases. This frequently triggered new rounds of within-case analyses: The practice or supply chain actors and collaborations identified from one case were also sought in other cases and, when found, they were conceptualized as general patterns. Through several analytical iterations between within and cross-case analyses, including cross-industry and country comparisons, we collectively replenished our theoretical conceptualizations displayed in a final framework (Fig. 3), a synthesis of areas of supply chain collaborations for CBMs (Table 5), and a research agenda (Table 6) for emerging crucial knowledge gaps.

To ensure the quality and trustworthiness of the results, we applied multiple analysis tactics and different types of triangulations (Flick, 2004): Researchers shared analysis frameworks and interpretation and analysis procedures, and there was ongoing discussion of case comparisons to implement *researcher triangulation*, and *data triangulation* was actualized by collecting data from different primary and secondary sources from two different contexts. Next, we briefly describe the individual cases and then analyze them.

## 4. Case presentation

### 4.1. Case A

Forest industry-based Company A first developed a CBM around 2012: *"It started with our wood-plastic composite innovation"* (Service Director), which enabled the use of the side and waste streams of Company A's wood-based label material production.

The objective of the CBM is to collect label release liner waste and turn it into innovative wood-plastic composite and paper products. Doing so *"offers a promising closed-loop solution, and scaling this would accelerate the company's drive for material circularity"* (Ellen MacArthur Foundation's analysis assessment report for Company A; news release quotation). Although the original idea was to collect the company's own side and waste streams, the idea grew into a commercialized service that scaled up with the help of digital technology applications: *"We extended the [label release waste collection] service [from our own production plants] and offered it to all our customers and their customers"* (Service Director).

Company A realizes value creation through changes in collaborations with direct customers (e.g., label converters) and end-customers (e.g., brand owners): Through new collaborations, customers and end-customers now learn from Company A how to modify their own processes and systems to allow collecting waste efficiently from their own production and organize its collection for the take-back system. With over 200 global network partners, Company A coordinates the waste collection as part of its daily logistics planning. This means enhanced communications with a logistics service provider, who needs to consider the reverse logistics when utilizing its sub-contractor network in order to transport waste with fourth-party logistics principles.

To enable value transfer, Company A expands the scope of customer collaborations to plan together how to promote the CBM to the end-customers: *"We have recognized this service to be one of the strongest—if not the strongest—ways to open the dialogue [with end-customers]"* (Service Director). Hence, the close collaboration with direct customers has new agenda due to circularity and allows engaging both direct customers and end-customers to the CSC.

To capture CBM value from the customer/end-customer perspective, the collaborations need to communicate that the collection service offers reduced waste disposal costs and landfill, improves recycling rates in production, and meets regulatory requirements. This builds a responsible and circular-oriented reputation compared with traditional waste management methods. Furthermore, from Company A's perspective, value is captured in the CBM via collaborations with extended scope for developing take-back systems: *"We are eager to collect that waste, and they do not have to pay for its treatment, it is a useful raw material for us"* (Head of Strategic Partnerships; quotation from news release).

### 4.2. Case B

Traditional oil refiner, Company B, started designing a CBM based on a technology innovation for transportation and aviation fuels that expands and creates new life cycles for renewable feedstocks, while reducing emissions throughout the fuel life cycle by up to 90% compared with fossil fuels.

The shift from a fossil-based fuel to a circular business model was enabled by global waste and residual sourcing and innovative raw material processes: *"Our business model is rather unique in the world; no other similar model procures so many different feedstocks from around the globe"* (Senior Vice President of Sustainability and Public Affairs).

Value creation in the CBM relies on establishing long-term collaboration with a globally extended supplier network for vegetable oil, animal fat, waste, and residue. Here, an understanding of the diversified supply streams and their limitations is augmented through supplier collaboration, differing from the traditional BM's contract-based supplier relationships for Russian raw oil. The need to maintain long-term supplier collaboration and establish new renewable feedstocks supplier collaborations is always present: "*We can still do a lot by going toward waste and residue and looking for waste streams that are not yet used, for example because they are of worse quality"* (Key Account Manager, Nordic Region). This is because, *"the further we go in this feedstock scene of waste streams, the less it is possible to get those nice 10-kiloton-sized shipping deliveries straight to our production plants"* (Head of New Feedstock). To learn how to operate with a wider range of renewable feedstocks, Company B collaborates in joint R&D and participates in research consortiums with research institutions, customers, and other companies, including its competitors. Managing the increasing variety of supply streams and supplier collaborations is facilitated by digitalization technology, which allows tracking the material streams and enables development of an internationally certified transparency system for SC sustainability, strictly demanded by customers and non-governmental organizations (NGOs). Collaboration through open discussion and meetings with NGOs created opportunities for Company B to learn how to manage SC in a sustainable way. Interestingly, regulation also shapes supplier collaborations. For example, the European Union's Renewable Energy Directive 2 often impacts raw materials and their volumes, emphasizing the use of certain feedstocks, such as algae, whereas national level regulation defines where the renewable fuels can be commercialized, requiring Company B to collaborate with regulators.

To transfer the value of the CBM, Company B works in close collaboration with strategic customers to discover together new ways for reducing their emissions. Close collaboration for value transfer also allows new sources of value creation, such as the reverse logistics of specific strategic customers, which allows customers' waste to be turned into feedstocks in order to refine renewable fuels.

The value capture in Company B's CBM rests not only on the higher price margins of technically more advanced renewable fuels but also on providing customers with new ways to decrease their carbon footprint in order to achieve their sustainability goals and enhance their sustainable brand image. To achieve this aspect of its CBM's value capture, new types of communications are needed as part of customer collaborations. However, the CBM does not introduce new types of collaboration in supply chains to capture this value.

 

### 4.3. Case C

Company C noted that the cost of using soil in infrastructure construction is mainly due to logistics and landfill regulations, rather than the soil materials themselves. Therefore, the company found economic potential in establishing a circular solution and a CBM for soil reuse.

As part of its sustainability goals and due to the perceived economic benefits, construction Company C introduced circularity into its business model by reusing soil materials within and between infrastructure construction projects: *"This [reusing soil materials] is a simple thing, there are surpluses, and they are used where there is a lack"* (Retired Head of Environmental Affairs, Infrastructure Construction).

Value creation *"is about removing soil and replacing it with other types of soil, and there the core is to manage this process and its logistics efficiently"* (Development Engineer). The value creation dimension of the CBM requires many operational changes to be made in collaboration with partners: *"It requires land, city planning and zoning, refining of excavated soil, temporary storage, and an internal or inter-organizational system"* (Retired Head of Environmental Affairs, Infrastructure Construction). Soil material reuse is not coordinated at the corporate level in Company C. Instead, reuse is tightly bound to each ongoing construction project, with each construction manager independently handling soil material recycling at each construction site. Consequently, efficient soil reuse requires establishing and developing different collaborations for individual projects. Consistent reuse of soil material between projects requires increased project coordination in the project pre-phase collaboration, particularly with clients and public organizations, as well as collaboration for logistics optimization (e.g., soil transported from one site to another, and short-term storage only). To facilitate collaboration between involved parties to circulate soil and measure the circulated soil amounts, Company C utilizes advanced digital data management. Collaboration is also needed with local authorities and regulators to influence the regulation for soil storing throughout the supply chain.

Value transfer in the CBM depends on project-specific circumstances. Generally, supply chain collaborations and communication must be established with sub-contractors, who transport the soil materials for reuse in alignment with their core business; client companies and municipalities, who suggest reuse purposes for the soil materials in line with longer-term perspectives on appropriate upcoming projects; and competitors and other internal construction projects, who can either provide soil materials for use or order soil materials for their own reuse purposes. Company C also communicates the environmental impact of soil reuse in projects externally to engage customers and suppliers.

Although this CBM provides value in multiple ways to both Company C and its supply chain collaborators (e.g., cost savings for both material provider and recipient), the value capture dimension of the CBM has not developed new supply chain collaborations.

### 4.4. Case D

Coffee and food processor Company D started its journey toward CE by recognizing *"the amount of value of metals completely wasted when the used coffee cup is thrown in the garbage by our customers"* (Head of Sustainability).

The CBM of Company D is based on a purposively redesigned recycling process for used cups, which allows the technical (aluminum shell) and biological (coffee waste) materials to be separately recovered for further exploitation in new supply chains.

The value creation dimension of the CBM was initially built through a newly established collaboration with an Italian association of recyclers. "*It was the first time we talked to recyclers, as we were not used to recovering the product after being used by the customer. We were aware of the job of recyclers, but we considered it outside of our business"* (Member of the Sustainability Team). Based on the interactions with this association, a set of local recyclers in the area of the Italian headquarter of Company D was selected to design and pilot the new process. This collaboration involved engineers and technicians from both sides and resulted in a process that included a washing treatment to separate coffee waste from the metal cups and a process to separate the cover of the cup from the shell (which is made of pure metal). The shell is then ground to obtain the recyclable material. *"The initial investment was made by the company, but we wanted to be sure of the final result before engaging our customers"* (Head of Marketing). When the process proved to be efficient and sustainable from environmental and economic perspectives, the company began working on the reverse logistics chain to collect used cups. *"We had to re-negotiate all the contracts with the logistic providers to make this possible. Recovering exhausted cups also required us to be compliant with different types of regulations"* (Member of the Sustainability Team).

After the value creation, Company D designed the value transfer dimension in its CBM. The role of dealers and local shops was of paramount importance to engage customers in collecting used cups. "*We had to convince our dealers and final shops to work more closely with us"* (Member of the Sustainability Team). Also in this case, even if the collaboration with the dealers was already in place, it had to be purposely extended to include additional activities (collection and storage of exhausted cups) with their related reward systems. Company D did not want to compromise product quality: *"We wanted to keep the same taste and experience for the final customer"* (Head of Marketing). Therefore, Company D initially launched in a large Italian city, where cups were collected from local shops. After returning used cups, customers received discounts on the new supply of fresh cups. When the process began producing sufficient material, Company D established two additional collaborations. In the first, a specialized organic fertilizer producer (again a new supplier) composted the coffee waste from the cup-washing process. The second collaboration was established with a local rice producer (new customer), belonging to the supply chain of industrial agriculture, in order to exploit compost production. The compost is used to grow rice on a local farm, and the rice is bought and donated to charity via a sustainability program in which the company devotes some of the economic returns made by metal recycling. *"We felt this was part of how we could be more sustainable"* (Head of Sustainability).

Finally, the value capture dimension for Company D is based on a pilot program for recursive buying, mirroring a PSS model based on pay-per-use relationship, and enhancing company-customer engagement. For this pilot program, Company D was able to exploit its existing network of dealers, linking the recursive buying program to the reward scheme developed for supporting the value transfer dimension of the CBM.

### 4.5. Case E

*"For each tent made, about 10% of the fabric is discarded. This is unsustainable from both an economic and an environmental perspective"* (Head of Marketing). Company E is a leading producer of high-quality tents and other textile products, and its approach to CE started after the company explored improvements to its production process efficiency. *"We were already topping our production efficiency, so the only way to reduce waste is to find an alternative use for it"* (Head of R&D).

Company E's CBM was built upon the idea of using the waste of acrylic curtain fabrics (the main input for the company's production of tents) to create new and higher-quality fabrics which, blended with virgin fibers, could be used as input in textiles (mainly carpets) and furniture (mainly sofas and chairs).

The value creation dimension of the business model started with the establishment of a new collaboration with a few R&D companies actively sought and involved by Company E to support the internal R&D department (textile chemists) in the design of a mass-dyed, outdoor acrylic-fiber-recycling system. "*We had the idea it could work, but we need to access also new competences on the production processes"* (Head of R&D). The resulting material derives entirely from acrylic curtain fabrics and consists of a by-product with no real extant reuse value (being disposed

**Table 4**
Key CE collaborations in the six industrial companies.

| Cases/type of collaborations | Case A | Case B | Case C | Case D | Case E | Case F |
|---|---|---|---|---|---|---|
| Collaborations for reverse logistics | Reverse logistics create take-back systems for linear waste from direct customers | Arranging reverse logistics to collect partners' waste and turn it into fuel which can be bought back by the partners | Willingness to arrange reverse logistics, primarily for economic and practical reasons | Established with logistics providers to collect used cups from dealers and local shops | Established with logistics providers to collect production waste from competitors | Established with logistics providers to collect used wood and production waste |
| Collaborations for Design for X | Hands-on guidance for customers to adjust internal processes as required to implement the service in practice | Collaboration with, e.g., research institutions to learn about utilization of increasingly sustainable raw materials in the production process | Early construction project planning and design for soil reuse | Established with recyclers to design a dedicated metal/ organic recycling process | Established with R&D companies to design the new production process | Established with R&D companies to design the new production process |
| Collaborations for resource-efficient strategies | – | – | – | – | – | – |
| Collaborations for customer engagement/ communication | Emerging practice: Collaborating with and engaging direct customers to promote the service to end-customers | Close collaboration with strategic customers to help them reduce their emissions | Engaging customers in early project planning to utilize their long-term horizon to identify future soil reuse opportunities | Established with dealers and local shops to engage customers in collecting used cups | Established (in the form of a consortium) with textile and furniture producers to exploit new markets for recycled fabric | |
| Collaborations for customer/ supplier engagement/ communication | – | – | Emerging practice: Increasing communications and awareness of the environmental impact of soil reuse in projects | Established with a new supplier (specialized organic fertilizer producer) to turn the coffee waste into compost Established with local rice producers (customers) to exploit compost production | – | Established, in the form of a consortium with other producers and recyclers, to expand the network of suppliers of input materials for recycled panels |
| Collaborations for multi-channel engagement/ communication | – | – | – | – | – | – |
| Collaborations for take-back systems | Collecting back the linear waste after use from direct customers (via reverse logistics when possible) and end-customers | – | – | Established with dealers and local shops to collect back used products | – | Established (tentatively) with members of the consortium to collect used products |
| Collaborations for pay-per-use | – | – | – | Promoting a pilot for a pay-per-use customer relationship as part of the take-back system | – | – |
| Collaborations for pay-per-performance | – | – | – | – | – | – |

of in landfill under current legislation). The recovered material reduces the consumption of primary raw materials, thus having a significant long-term impact.

Initially, to expand the sources of inputs beyond the internal waste, Company E established a collaboration with logistics suppliers in order to collect waste from their competitors. *"We started addressing our competitors by telling them we wanted to collect their waste. Their initial reaction was priceless"* (Head of Marketing). This had a positive financial impact, as the new materials and recycled fibers collected accounted for 50 to 70% of the weight of the final product, with blends of other natural and synthetic fibers accounting for the remainder.

To ensure the value transfer, Company E found new customers for the recycled fabrics. The new yarn cost more than the yarn commonly used in the awning industry, thus making it difficult to be used in the Company's original business. However, the characteristics of the new fabrics meant that they could be upcycled in such a way that textiles and furniture could benefit from their original features, such as color fastness against ultraviolet rays, and stain-resistant and anti-mold properties. Company E worked hard to set up a consortium of potential users among textile and furniture producers interested in buying new fabrics. Establishing a consortium of customers was the only way Company E could engage companies belonging to other industries and make them aware of the new products.

The value capture dimension of the business model was not yet in place when our study of Company E came to an end.

### 4.6. *Case F*

Company F is 50 years old and is one of three business units that make up a larger holding company operating in the wood and resins sector. The industry includes wood panel production, chemical/material R&D, and production and sales of ready-to-assemble (RTA) furniture. The CEO explained that *"we were not satisfied with the quality of our recycled wood products, so we decided to develop a recycling process ourselves."*

The CBM of Company F is based on a wood panel made with 100% recycled wood to be further used in the group's RTA furniture business. The introduction of the new panel allowed the company to reduce virgin materials bought for its furniture business almost to zero, thus creating a loop from wasted wood to furniture.

The value creation dimension of the business model started when Company F entered into a new collaboration with an independent R&D company in order to develop and tune the process of producing its special panel. "*We were sure it could have been done, but we needed an external check. This was also critical to get the internal approval of the idea.*" (Member of the marketing team). When the product was tested and determined to be economically and environmentally sustainable, Company F faced the challenge of creating a chain of suppliers large enough to collect the waste and used wood needed for production. "*Once the process was ready, we thought … and now how can we source enough wood?*" (CEO). As with the case of Company D, also here, the Company had no connections with recyclers, due to the fact they worked outside the linear chain of its traditional business. Company F was thus forced to establish new partnerships with several recycling facilities in order to collect used furniture and increase the amount of material processed every year. To ensure that the flow of materials is effectively managed, Company F extended also existing collaborations with its logistics suppliers to set up regular connections with the recyclers.

The value transfer dimension of the CBM for Company F was achieved by exploiting, in a different way, its connections with other players in the industry, successfully establishing a consortium of > 40 producers of wood products willing to adopt the new panel. *"We approached other players with a transparent statement, involving them in an ethical industrial development"* (Head of Marketing). Members of the consortium use Company F's panels for their production and provide production waste to Company F. The network of logistics suppliers has been further extended to include consortium members in the collection process.

Recently, Company F has experimented with the collection of used furniture from the commercial enterprises (e.g., showrooms) run by the consortium members, mirroring a take-back program. The value capture dimension of the business model is still in the initial development phase.

## 5. Results

### *5.1. Key CSC collaborations for CBMs and increased circularity in the six industrial companies*

As discussed, concerning the theoretical framework, we postulate that supply chain collaborations play a key role in the design and implementation of industrial companies' CBMs. The evidence collected from each case study is shown in Table 4. The presence and purpose of the collaborations for CE in each case are highlighted.

Evidence suggests that loop closure, through proper reverse logistics, is important for the development of CBMs (Bernon, Tjahjono, & Ripanti, 2018). Even if logistics are commonly externalized, new collaborations must, in all cases, be established to properly design the characteristics of the reverse logistics service. In some cases (Companies A, D, and F), reverse logistics was an enabler of take-back systems implemented to connect with customers and/or end-customers and recall the materials needed for circularity. Regarding value capture, take-back systems are the only systems in place. None of the considered companies has adopted pay-per-use or pay-per-performance approaches or established related collaborations. Such customer interaction models, even if they fit the CE approach, are among the most difficult to implement (Sousa-Zomer, Magalhães, Zancul, & Cauchick-Miguel, 2017) and only companies at the end of their circular transformation journey are effectively dealing with them.

Concerning value creation, collaborations are also commonplace in the development of Design for X practices for circular products implemented by the companies. The companies partner because they lack internal competencies (Sassanelli et al., 2020). To properly design a circular product, in-depth knowledge of the product's life cycle and components, including dismantling and end-of-life treatment processes, is needed (Cong, Zhao, & Sutherland, 2017). The desired level of knowledge is far beyond that required in a linear economy. Furthermore, in almost all cases (even those which do not require collaboration in this phase), the journey toward CE starts with (re)designing the product, which leads to the transformation around which all other changes in the organization and supply chain collaborations are then arranged. Similarly, the absence of collaborations for resource-efficient strategies is consistent with the argument that companies adopting a CE approach are aware of the relevance of environmental sustainability (Di Maio, Rem, Baldé, & Polder, 2017). Therefore, all the companies internalized the competences needed to make their internal processes energy and material resource efficient.

Finally, concerning value transfer, the role of the collaborations used to expand the companies' ability to effectively communicate new approaches to customers and suppliers is important. CE demands broader and closer collaborations with customers and suppliers, as they are involved in recurrent, circular flows of products and materials (De Angelis et al., 2018).

The collected evidence sheds light on the forms of collaborations and the actors involved. In all cases, the companies (re)designed products and made significant changes in their supply chain, both as actors (that connect to other industries, such as fertilizers in Company D) and organizational form (e.g., the collaboration networks established by Companies A, B, and F). The need to expand existing networks in order to embrace CE and to explore forms of collaboration that are more consistent with the types of relationships established (e.g., a consortium of peers) aligns with the literature (Lahane et al., 2020).

### *5.2. CBM practices and CSC collaborations: Case comparison*

The companies can be compared using the framework we developed (see Fig. 1). Fig. 2 summarizes the adoption of a specific CBM practice, as described in the theoretical framework, regarding the CSCM objectives. The analysis and comparison also revealed how the ongoing CE transition was reflected in the companies' businesses. We identified many emerging managerial practices that were being developed, adopted, or implemented in industrial companies and their supply chain networks. A 'full' circle indicates the practice is fully in place, and a 'dotted' circle means the practice is emerging among the companies.

The discussion of the business model dimensions clearly reveals that only a few practices for value capture were adopted. Concerning value transfer, only practices related to closing material flows are in place, and the role of platforms seems marginal. The lack of a well-developed CE platform ecosystem (i.e., a dedicated platform for resource-sharing Aarikka-Stenroos, Ritala, & Thomas, 2021; Schwanholz & Leipold, 2020) requires companies to leverage collaborations in order to ensure loop closures within their own network. Companies focus on value creation, where practices dealing with Design for X (Sassanelli et al., 2020) and reverse logistics (Julianelli et al., 2020) clearly drive the supply chain (re)organization. Collaborative practices are lacking in the narrowing of material flows because companies exploit present market services for energy efficiency in Italy and Finland, and they do not need to collaborate. Furthermore, many industrial companies have focused on optimizing their businesses' material efficiency for cost efficiency (closing and slowing); companies' strategic collaborations to narrow material flows have not been found. However, value capture involving customer relationships requires further modification and reflects the challenges that pay-per-use modes face in diffusion among customers (Kjaer et al., 2019; Tukker, 2015).

### 5.3. Summarizing and proposing the final framework

The analysis results revealed new actions related to the implementation of supply chain collaborations in CBMs that have not been identified in the existing literature. Thus, a theoretical framework was developed in the final conceptual model, shown in Fig. 3, based on the multiple case study to generate a more structured and detailed understanding of industrial companies' potential activities and practices in supply chain collaborations in order to design and implement CBMs. Current developments among industrial companies focus on closing and slowing material flows from the CSCM perspective. From the business model perspective, the developments focus on value creation and value transfer. However, the relative lack of collaboration activities for value capture emphasizes that further developments are required.

For closing strategies in value creation, in addition to the reverse logistics processes necessary to close the loop between the user and post-use production (Julianelli et al., 2020), we identified that supply chain collaborations for biological materials emerged to effectively extract renewable biological materials in the CBM. For example, in Case B, novel supply chain collaborations were necessary to replace fossil fuel raw materials with renewable biological feedstocks. Also, design for environment collaborations were identified to close material flows for biological materials. For example, in Case D, collaborations to design cups and their recycling process were necessary to close the material flow. Value transfer-related collaborations emerged as important in closing material flows. Multi-channel communication collaborations (Urbinati et al., 2017) were complemented by supply chain actors to validate and improve the value proposition of CBM loop closures. Case C highlighted the importance of early collaboration with clients and public organizations to ensure that the value proposition was desirable and that it could be achieved. Collaborations for take-back systems (Corvellec & Stål, 2019) were validated as part of the framework in Case A, which had established suitable supply chain collaborations with customers and end-customers.

For slowing strategies, collaborations for value creation were identified. Existing research has identified that collaborations for design practices for a product's materials and resources are necessary to extend its life cycle (Sassanelli et al., 2020). These results deepened the collaboration objectives. Design for disassembly and standardization is a collaborative practice that slows material flows in the supply chain by enabling multiple actors to contribute. For example, in Case E, the entire packaging chain participated in the take-back system for fabric waste.

For value transfer, sharing platforms identified in the literature (Berg & Wilts, 2018) also emerged in some cases. For example, Case C identified digital technologies as useful for communicating with companies about upcoming projects and potential improvements for suitable soil reuse project identification. Representing an information-sharing platform between producers, Case F was part of a > 40-producer consortium that ensured the use of ecological panels in products.

For the narrowing strategy, we did not identify any significant collaboration activities. In the literature, narrowing strategies have been linked with energy-efficient strategies (Diaz Lopez et al., 2018). Thus, the focus on energy efficiency in the case companies' markets could have diminished the emergence of these activities in the CBM design and implementation. However, there is a severe lack of collaborations in the value capture dimension of the business models; only a few cases implemented partnerships/relationships in the form of take-back systems with revenue sharing. Collaborations for PSSs (Kjaer et al., 2019) or customer-facing sharing platforms (Schwanholz & Leipold, 2020), both of which have large impacts on companies' value capture systems, were not identified in any of the cases. There is a contrast between the ubiquity of collaborations for value creation and the lack of collaborations for value capture. This finding reflects the existing literature on CBMs, which indicates that models for implementing CBMs have become plentiful (see for example Lüdeke-Freund et al., 2019), whereas identification of value emergence from CBMs remains nascent (Ranta

**Table 5**

Synthesis: How industrial companies' CBMs can be supported via supply chain collaborations and CSCM (Thematic areas, aspects to be managed and empirical examples).

| Thematic and research areas | Aspects to be managed and link to theory | Rationale and case example/validation |
|---|---|---|
| How companies' CBM and business (practices, strategies) is supported via supply chain collaborations (at micro level) | | |
| Managerial practices improving CBM implementation via supply chain collaboration | Design practices (González-Sánchez et al., 2020; Mishra et al., 2018) | Companies implemented circularity with partners through design practices concerning new products, materials, services, and processing.<br>• Case E designed coffee waste; Case A designed label-waste upcycling products and processes. |
| | Communications practices, including branding (Julianelli et al., 2020; Lüdeke-Freund et al., 2019) | Circular solutions by companies demanded branding to highlight and demonstrate the circular offering collaboratively enabled with partners:<br>• Case A branded the circulated, loop-closing novel composite material; Case B branded its renewable fuel, and Case E branded a new fabric through a consortium of customers |
| | Logistics practices: Organizing and reorganizing logistics of existing supply chains, enabling reverse logistics (De Angelis et al., 2018; Farooque et al., 2019; Govindan & Hasanagic, 2018; Lahane et al., 2020) | Companies collaboratively harnessed new collection logistics to reprocess waste, reverse logistics, and implement take-back systems, for example involving customers:<br>• Case A gathered label waste to reproduce it as composite; Case C optimized soil use and transportation; Case D collected coffee waste. |
| CBM development and innovation fueled with circular supply chain collaborations | Value proposition-related aspects (Fehrer & Wieland, 2020; Ranta et al., 2020) | New value propositions by industrial companies were enabled as circular-modified supply chains to provide more recyclable/upcyclable/optimized and, therefore, more sustainable products/materials:<br>• In Case A, wood-plastic composite, and in Case F, recycled wood panels were an upcycled alternative to wood products; in Case B, renewable fuel was a regenerative alternative to fossil fuel.<br>Interestingly, in the studied cases, less transition toward "as a service" and product-service systems was realized with supply chain actors. |
| | Value delivery and transfer-related aspects (Centobelli et al., 2020; Geissdoerfer et al., 2018; Kirchherr et al., 2017) | More value and diverse value elements were delivered to customers and supply chain partners through collaborations: |

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**Table 5** (*continued*)

| Thematic and research areas | Aspects to be managed and link to theory | Rationale and case example/validation |
|---|---|---|
| | | • In Case B, local customers could provide their waste to be turned into fuel and gain different economic, symbolic, and environmental benefits. |
| | Value capture-related aspects (Tukker, 2015; Urbinati et al., 2017) | Companies faced changes in their revenue models but captured the value via higher price or via reduced waste management costs in the value chain:<br>• In Case B, non-fossil renewable fuel is a feasible, higher-priced substitute in engines but requires supplying different waste frictions and residuals efficiently from customer-suppliers. Case E's recycled yarn was high-priced. Cases A and C decreased chain waste management costs. |
| Innovation and product/service development realized through circular supply chains | Diverse innovation types driving business model change and supporting circularity in supply chains (De Angelis et al., 2018; Engez, Ranta, & Aarikka-Stenroos, 2021; Govindan & Hasanagic, 2018; Ranta et al., 2020) | Joint R&D and innovation enabled industrial companies with supply chain collaborations to increase circularity and sustainability of their products or operations, relevant for their CBM.<br>• Tech innovation in Cases A and F (wood composite), service innovations in Cases A and D (taking waste back for reprocessing), process innovation in Case D (washing), Case C (cross-site soil coordination), and Case E (fiber processing) all enabled circularity with and via the supply chain. |
| Strategic development and strategic partnerships via supply chain collaborations | Circular supply chain collaborations as a part of the company strategy (Govindan & Hasanagic, 2018; Hazen et al., 2020) | The strategic role of the supply chain collaborations (enabling circularity) in the company's core business model and strategy varied:<br>• Case B strongly renewed its business model and business strategy with new strategic supply chain partners, whereas Case C pursued a new, more circular operational model for its normal core business with replaceable collaborators enabling circularity. |
| How companies' CBM requires broader collaborations between industrial companies and supply chain collaborations (extending the view of CBMs from micro to meso and macro-levels) | | |
| Digital technologies and tools enabling and advancing circular supply chains and CBM feasibility | Digital data gathering, sharing, and processing, and digital sharing platforms (Bressanelli et al., 2019; Bressanelli et al., 2021; de Sousa Jabbour et al., 2018; Ranta et al., 2020) | Digital technologies enabled industrial companies to interact, manage, and coordinate their supply chains, as well optimize material use, material processing, or logistics with supply chain actors.<br>• In Case B, digitally steered renewable fuel processing produces high-quality fuel from very versatile waste and regenerative resources from the supply chain. In Case C, digitalized data and communication between the company and the client optimized soil reuse. |
| Novel collaborations, and changes in relationships initiated for circular supply chains | Need to initiate radically new collaborations, strategic partnerships and co-opetitive relationships (De Angelis et al., 2018) | Novel, even unconventional and co-opetitive, collaborations were initiated.<br>• In Case A, the company collaborated with waste logistics providers to collect waste for company reprocessing; in Case B, diverse waste resources were supplied by radically new partners for renewable fuel processing.<br>• Case C showcased co-opetition for circularity, as the company collaborated with other construction companies to reuse soil, as did Case E when it collaborated with awning producers. |
| | Need to form novel close collaborations for circular resource flows (De Angelis et al., 2018; González-Sánchez et al., 2020) | Close, tight industrial symbiosis-kind of collaborations emerged.<br>• In Case D, coffee waste was turned into compost through a specialized supplier. |
| Collaborative industry and market developments, due to sustainability and circular economy transition, to allow and strengthen companies' CBM at market and society | Need to collaborate for industry development and sustainable industry norms (new "rules" for the industry) (Bressanelli et al., 2019; Hazen et al., 2020) | Companies collaborated for industrial development and survival, as their co-evolution toward circularity and developing industrial norms improved the sustainability of the whole industry and therefore also CBM feasibility.<br>• In Case C, construction companies, in Case B, fuel and transportation companies, and in Case E, textile and fiber companies together collaborated due to tightening sustainability pressure concerning these environmentally burdensome industries. |
| | Need to collaborate through policy making, and regulation and social | Companies co-advance market development and societal acceptance for |

(continued on next page)

**Table 5** (*continued*)

| Thematic and research areas | Aspects to be managed and link to theory | Rationale and case example/validation |
|---|---|---|
| | institution shaping to accelerate and ensure societal acceptance of circularity and CBM (Govindan & Hasanagic, 2018; Kaipainen & Aarikka-Stenroos, 2021; Närvänen et al., 2021) | circular solutions via policy making, regulation, institutional work, and shaping social institutions. This creates avenue for companies' CBM in long run.<br>• In all cases, a change in the mindsets and regulations concerning recycling materials and using recyclable or renewable instead of virgin and/or fossil fuel materials supported industrial companies and their supply chain actors in the circular business implementation, and vice versa.<br>• Some case regulations also inhibited the formation of supply chains (e.g., Case B). |

et al., 2020). Importantly, research on how to appropriate wider and more dispersed value (Kirchherr et al., 2017) between necessary collaborators is missing. Thus, the results show that companies choose CBMs that allow them to maintain control of the business model and, therefore, profitability as opposed to business models where wider collaboration throughout value creation, value transfer, and value capture is necessary to ensure value emerges alongside profitability. Existing research suggests that this single company-focused supply chain perspective is problematic in the development of sustainable supply chains (Frostenson & Prenkert, 2014). In a CE, companies can rarely effectively close loops alone; instead, collaborations in the upstream and downstream supply chain should be pursued (Urbinati et al., 2017). Thus, the findings highlight that, in the cross-section of supply chain and business model research, a meso-level perspective on activities is called for. This issue not only prevents the holistic implementation of CSCs but inhibits the emergence of systemic, macro-level sustainability improvements that the CE is expected to deliver (Ghisellini et al., 2016; Murray, Skene, & Haynes, 2017).

## 6. Discussion: A synthesis of key findings on companies' CBM design and implementation enabled by supply chain collaborations at micro, meso, and macro-levels

This multiple case study explored how industrial companies' CBM design and implementation leads them to collaborate with their supply chain actors. Therefore, we started to examine this with a "portfolio" approach, putting the company with a CBM not only in the center, but also examining the supply chain collaborations that enable the company to actualize its circular business: thus, we moved from company-centric micro-level toward more relational, collaborative developments in the focal chain, industry and market at meso and macro-levels. The investigated industrial companies' CBMs and related collaborations were also found to be dynamic (not static) constructions.

Our synthesis (Table 5) discusses how and why supply chain collaborations support industrial companies in their CBM design and implementation. It explains where companies' CBM implementation, indicated in our framework (Fig. 3), leads them in their supply chain collaborations. In big picture, to implement a CBM, companies need also to innovate, strategize, digitalize and shape regulative institutions, in collaboration with diverse supply chain actors. Thereby, our synthesis includes our framework elements (Fig. 3) and display that CBM implementation leads to many collaborative practices and operations (ranging from branding to logistics and reverse logistics). Moreover, due to our exploratory, theory-developing approach, synthesis includes also emerging elements that broaden the view to the needed collaborations: companies' CBM design and implementation require chain and industry level collaborations at meso and macro-levels (ranging from increased digitalization or redesign of the whole chain to market creation and industry-level joint actions for regulation development) that strengthen companies' CBM feasibility and performance by changing the rules of the game in the industry, market and society. This means that companies need to manage diverse collaborations in order to enable their CBM. Therefore, Table 5 synthesizes the seven thematic areas of companies' supply chain collaborations for CBMs to be managed. These seven themes are theorized from general patterns from our data and are validated with our empirical multiple case cross-comparisons and, therefore, assumingly applicable to different businesses, industries, and regional contexts.

At the micro-level, we found a set of managerial practices, comprising design, communications, and logistics, enabled by supply chain collaborations. Companies' business model development necessitated the reorganization of existing relationships and the creation of new collaborations to ensure the circularity of operations. Joint technology development, R&D, and innovation activities (particularly in cases A, B, D, and E) and implementation of digital tools (in cases B and C) trigger and enable implementation of CBMs and deliver and capture value from circularity. Furthermore, the value dimensions through which customers evaluate value extend beyond the economic value of CBMs. This requires further development of marketing argumentation practices to convey a larger value spectrum to customers and partners. Customer investments in a CE are also catalyzed by service contracts, where customers shift some of the risks to the supplier. These contracts require practices for new financing arrangements, as with cases A and D, which used take-back systems. All these were done via supply chain collaborations.

At the meso and macro-levels, we found that industrial companies' CBMs provoked and required digitalization and collaborative arrangements and initiatives for increased circularity, both within and across the industry, even with competitors (Table 5). Interestingly, many micro-level developments led to meso and macro-levels collaborative developments, due to companies' circular sourcing and offerings, which allowed some to transcend their conventional supply chains and industry sectors (cases A, B, and D) and realize their CBM, whereas others remain in their existing conventional chains (cases C, E, and F). Circular companies' collaborations tend to spill over into larger stakeholder interactions through collaborative initiatives, such as the joint development of industry norms and social institutions to provide better support for CSC and CBM implementations, not only in the industry sector but also throughout society.

## 7. Conclusions

### *7.1. Theoretical contributions, future research agenda, and limitations*

The present multiple case study provides several contributions to the literature. The first is the proposed framework, that integrates circularity, supply chains, and business models by incorporating theoretical knowledge from disconnected research streams of CBM and CSCM and empirical insights (Fig. 3). We explained how companies' CBM design and implementation necessitates collaborations with supply chain actors. The intersection of CBM and CSCM has been under-researched (De Angelis et al., 2018), with no clear CE agenda in the business model perspective concerning supply chains (Govindan & Hasanagic, 2018); however, the study fills this knowledge gap. Concerning sustainability and circularity on the 'B2B' and industrial business research continuum, we responded to recent calls to investigate the implementation of CE from a company-level perspective (i.e., the micro level), particularly in industrial-scale businesses (Ranta et al., 2020), in order to complement recent discussions of the start-up perspective (Närvänen et al., 2021). Our multiple case study of six industrial companies explored the CSCs and other collaborations needed to increase circularity in their business models. Concerning the emerging CBM research in 'B2B' and industrial business research, we developed a structured understanding of the value creation, value transfer, and value capture dimensions of industrial companies' CBMs, realized through supply chain collaborations. Thus, the study complements previous studies on the value proposition aspects of a business model by identifying what kind of value CE-aligned suppliers communicate to their customers (Ranta et al., 2020) and how industrial companies introducing CBMs can influence market perceptions to strengthen the model's value proposition (Närvänen et al., 2021; Press, Robert, & Maillefert, 2019).

Furthermore, the study extends the perspective from companies' internal practices to their collaborative relationships, meso-level chains and networks, and macro-level business environments. We mapped structurally industrial companies' collaborations with supply chain actors for circular business and explained what collaborative activities they need to manage for their CBM design and implementation (see thematic synthesis in Table 5). This contribution is important, as previous CE research in 'B2B' and industrial business have been limited to general stakeholder interactions for a CE and the sustainability (Ingstrup et al., 2021; Inigo, Ritala, & Albareda, 2020; Närvänen et al., 2021; Press et al., 2019). This accounts for the emerging need for CSCM (Bressanelli et al., 2021; Lahane et al., 2020; Sharma, 2020). The findings show how companies' collaborations with supply chain actors advance their value creation potential, though companies are still learning about circular value transfer and value capture practices that would ensure that all actors in the chain are able to benefit. This aligns with existing literature suggesting that management of CSCs allows companies not only to enhance value creation (Guide & Van Wassenhove, 2009), but also to connect to meso and macro-levels (in the study via CSC collaborations with new partners) across supply chains and industries (see also De Angelis et al., 2018).

Concerning the sustainability and CE research stream, by analyzing how circularity-seeking companies design and implement supply chains for increased sustainability, the present study extends existing CE and sustainable business model literature, focused on static CBM goals (Lüdeke-Freund et al., 2019), with much-needed empirical and industrial supply chain examples of how circularity is designed and implemented in practice in supply chains and integrated with business models (De Angelis et al., 2018; Ferasso et al., 2020; Govindan & Hasanagic, 2018; Hazen et al., 2020; Sehnem et al., 2019). The final framework, in Fig. 3, shows industrial companies' empirically mapped practices and CSCM strategies of closing, slowing, and narrowing material flows per business model dimension (Geissdoerfer et al., 2018; see also Bocken et al., 2016). The framework also provides insights into companies' real-life supply chain applications, by investigating these strategies together (Bressanelli et al., 2021). We identified that, although value creation practices related to the closing and slowing of material flows have been embraced in early-adopter companies, there is potential to improve CBM design and implementation by further embracing practices in the value transfer and value capture dimensions of a CBM. Furthermore, dematerialization strategies and service models (Bressanelli et al., 2021; Geissdoerfer et al., 2018; Hazen et al., 2020) for circularity were surprisingly rarely realized with supply chain actors in our cases. This finding raises the question of whether material processing-focused industrial companies are moving toward servitization and service models with their CBMs to realize intensifying and dematerializing CSCM strategies (Geissdoerfer et al., 2018; Hazen et al., 2020). These insights contribute to the understanding of required applications, success factors, and best practices in different industries and geographic areas with company-specific variables to implement circularity in supply chains

**Table 6**
Research agenda for further investigations on companies' CBMs and related collaborations.

| Research themes | Research topics and questions for future research |
|---|---|
| Companies' diverse managerial practices improving circularity via collaboration (micro) | *Design practices:*<br>• How can a company initiate and manage the design of materials, products, and processes in collaboration to enable circularity?<br>*Communications and branding practices:*<br>• How do companies communicate the circularity aspects of offerings with environmental impacts within and outside supply chains; How are customers and supply chain partners informed and advised about circularity?<br>• How is (industrial) branding applied by companies to increase circularity in their business models and industrial collaborations?<br>*Logistics practices: (Re)organizing the logistics of existing supply chains toward more circular*<br>• How do companies induce and enable reverse logistics, such as take-back systems, or optimize logistics for circularity and sustainability? |
| Companies' business model development and innovation via circular supply chains (micro) | *Value proposition and its development:*<br>• How are offerings redesigned in industrial chains, e.g., through service models and PSSs?<br>• How do industrial companies increase circularity through servitization; that is, does servitization promote circularity among industrial companies, or vice versa?<br>*Value delivery and transfer development:*<br>• How do diverse channels and platforms enable a company's CBM implementation?<br>• What do customers gain from a company's circular supply chain? What is the customer value?<br>*Value capture development:*<br>• How is value capture redesigned in collaborations?<br>• How are circularity benefits monetarized and turned into profit via supply chain collaborations? |
| Innovation in companies' circular supply chains (micro-meso) | *Diverse innovations driving companies' CBM and related collaborations*<br>• How do circular companies apply novel technologies, service models, product innovations, process innovations, and business model innovations to generate more economic and environmental value in and via supply chains? |
| Strategic development via supply chain collaborations (micro-meso) | *Circular supply chain collaborations as a part of the company strategy* |

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**Table 6** (*continued*)

| Research themes | Research topics and questions for future research |
|---|---|
| | • How do industrial companies' strategies develop due to CBM, and what does this mean for their relationship portfolio?<br>• What are the strategic collaborations and relationships for this purpose?<br>*Digital data gathering, sharing, and processing, and digital sharing platforms* |
| Digital technologies and tools enabling circular supply chains (micro-meso) | • How do industrial companies implement diverse digital platforms to enable circularity, e.g., match the resource provider and the need, or redistribute material resources?<br>• What digital tools improve optimization of resource/material and logistics, and management of circular-oriented production/service operations within the supply chain?<br>*Need to initiate new collaborations within the supply chain to increase circularity* |
| Novel collaborations for circular supply chains (meso-macro) | • What types of collaborators are the most crucial for companies' CBM and with whom particularly companies should tie collaborative relationships to advance the circular development at company, chain, and industry?<br>• What is the role of collaborations over conventional industry borders for a company's CBM?<br>• How does co-opetition support industrial companies' CBM?<br>• How do companies create close collaborations, such as industrial symbiosis, to ensure sustainable and profitable resource flows and resource efficiency strategies (the nexus of industrial symbiosis and supply chains)?<br>• How are circular supply chain partners and their specific resource-circulating processes identified, motivated, engaged, facilitated, and coordinated?<br>*Extensive collaboration for market creation and development; industry development and survival* |
| Collaborative industry and market development, due to sustainability and CE transition (meso-macro) | • How have sustainability and circularity goals changed the rules of the game among industrial companies and consequent industry-level norms and practices?<br>• How do industrial chains and industry sectors benchmark and learn more circular operation modes from other industries, through cross-industry development?<br>• What can an industry learn and benchmark from another industry or (private) sector to increase circularity (e.g., improved process design or coordination; take-back systems)?<br>*Collaborations for industry norm and institution development to increase circularity in society* |
| | • How do industrial companies with circular strategies and CBMs collaborate for societal and market developments and engage in policy making, regulation development, institutional work, and social institution shaping to support adoption and diffusion of circular principles? |

(Bressanelli et al., 2021; Lahane et al., 2020).

As the field is still developing, the comprehensive thematic synthesis displaying patterns from our multiple cases (Table 5) is developed the following research agenda (Table 6). The research agenda identifies the knowledge most urgently needed to further develop circularity in industrial companies' businesses, tightly connected to the surrounding networks and ecosystems.

As the research agenda proposes, many themes, varying from micro-level company-centric research settings to meso and macro-levels phenomena, require more investigation (see Table 6). Future research should deepen the analysis of companies' managerial practices (e.g., branding, take-back, or PSSs) that catalyze increased customer involvement in business models, reinforce the closing and slowing of material flows, and enhance downstream CSCs. The present study discovered that companies are more likely to establish collaborations with upstream supply chain stakeholders in order to create circular value and enhance upstream CSCs, which close and slow material flows. Therefore, the downstream chain and the role of customers in CBMs deserve more study. Furthermore, the types of collaborative relationships (e.g., partnerships) should be studied in order to understand the diversity and continuum of relationships.

We acknowledge that this explorative study has limitations. The present study highlighted select industrial company cases (processing and product/project-centric) that could bias the findings. All were material-flow-based businesses, and the sampling may have missed PSS aspects. Companies with more knowledge or service oriented CBMs may provide different answers. However, the sample of six qualitative cases, with similar characteristics of industrial-scale circular processing and product business (albeit with some variations), and case comparisons over regional locations and businesses, allowed us to identify patterns and make analytical generalizations (Baskarada, 2014). In the present study, we focused on companies' CBMs and collaborations following the relationship "portfolio" approach by Ritter et al. (2004). Therefore, we mostly gathered data from individual company perspectives. Richer case studies, with data from multiple actors from the supply chains and surrounding stakeholders, and diverse CE ecosystems (Aarikka-Stenroos et al., 2021), could develop deeper knowledge of inter-organizational collaborations, thus enhancing our network- and system-level understanding.

### 7.2. Implications for managers

The present study provides useful guidance for managers. The developed framework (Fig. 3), synthesis (Table 5), and agenda (Table 6) are pragmatic tools that can be used to identify important internal collaborative relational practices in order to make the business model more circular via supply chain collaborations. The framework and agenda indicate the most critical areas of supply chain collaboration that industrial companies should collaborate and why they should increase circularity. Thus, managers can be informed of the potential of supply chain collaborations for circularity and can be used to guide diverse operations from micro and meso-level to the macro-level. Finally, the framework identifies which collaborations are critical when developing each business model dimension of value creation, value transfer, and value capture for different CE principles. For example, for companies pursuing loop-closure in material flows, partnerships for reverse logistics, innovative processing, and renewable materials are crucial. Value propositions can be validated with partners that contribute to communicating the value of the business model or developing the market and society strategically. Collaborations for take-back systems, optimized processing, and industrial symbiosis can contribute to value capture while strengthening profits from the business model.

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## References

Aarikka-Stenroos, L., Ritala, P., & Thomas, L. D. (2021). Circular economy ecosystems: A typology, definitions, and implications. In S. Teerikangas, T. Onkila, K. Koistinen, & M. Mäkelä (Eds.), *Research handbook of sustainability agency* (pp. 257–273). Cheltenham: Edward Elgar Publishing.

Andersen, P. H., & Kragh, H. (2010). Sense and sensibility: Two approaches for using existing theory in theory-building qualitative research. *Industrial Marketing Management, 39*(1), 49–55.

Baskarada, S. (2014). Qualitative case study guidelines. *The Qualitative Report, 19*(40), 1–25.

Baxendale, S., Macdonald, E. K., & Wilson, H. N. (2015). The impact of different touchpoints on brand consideration. *Journal of Retailing, 91*(2), 235–253.

Berg, H., & Wilts, H. (2018). Digital platforms as market places for the circular economy-requirements and challenges. *Nachhaltigkeits Management Forum/Sustainability Management Forum, 27*(1), 1–9.

Bernon, M., Tjahjono, B., & Ripanti, E. F. (2018). Aligning retail reverse logistics practice with circular economy values: An exploratory framework. *Production Planning and Control, 29*(6), 483–497.

Beverland, M. B., & Lindgreen, A. (2007). Implementing market orientation in industrial firms: A multiple case study. *Industrial Marketing Management, 36*(4), 430–442.

Bocken, N., De Pauw, I., Bakker, C., & Van Der Grinten, B. (2016). Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering, 1015*, 1–12.

Bocken, N. M. P., Short, S. W., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production, 65*, 42–56.

Bressanelli, G., Perona, M., & Saccani, N. (2019). Challenges in supply chain redesign for the circular economy: A literature review and a multiple case study. *International Journal of Production Research, 57*(23), 7395–7422.

Bressanelli, G., Pigosso, D. C. A., Saccani, N., & Perona, M. (2021). Enablers, levers and benefits of circular economy in the electrical and electronic equipment supply chain: A literature review. *Journal of Cleaner Production, 298*, Article 126819.

Centobelli, P., Cerchione, R., Chiaroni, D., Del Vecchio, P., & Urbinati, A. (2020). Designing business models in circular economy: A systematic literature review and research agenda. *Business Strategy and the Environment, 29*(4), 1734–1749.

Cong, L., Zhao, F., & Sutherland, J. W. (2017). Integration of dismantling operations into a value recovery plan for circular economy. *Journal of Cleaner Production, 149*, 378–386.

Corvellec, H., & Stål, H. I. (2019). Qualification as corporate activism: How Swedish apparel retailers attach circular fashion qualities to take-back systems. *Scandinavian Journal of Management, 35*(3), Article 101046.

De Angelis, R., Howard, M., & Miemczyk, J. (2018). Supply chain management and the circular economy: Towards the circular supply chain. *Production Planning and Control, 29*(6), 425–437.

Di Maio, F., Rem, P. C., Baldé, K., & Polder, M. (2017). Measuring resource efficiency and circular economy: A market value approach. *Resources, Conservation and Recycling, 122*, 163–171.

Diaz Lopez, F. J., Bastein, T., & Tukker, A. (2018). Analysis business model innovation for resource-efficiency, circularity and cleaner production: What 143 cases tell us. *Ecological Economics, 155*, 20–35.

Dubois, A., & Gadde, L. E. (2002). Systematic combining: An abductive approach to case research. *Journal of Business Research, 55*(7), 553–560.

Eisenhardt, K. M. (1989). Building theories from case study research. *The Academy of Management Review, 14*(4), 532–550.

Engez, A., Ranta, V., & Aarikka-Stenroos, L. (2021). How innovations catalyze the circular economy: Building a map of circular economy innovation types from a multiple-case study. In Jakobsen, Lauvås, Quatraro, Rasmussen, & Steinmo (Eds.), *Research handbook of innovation for a circular economy*. Edward Elgar. Forthcoming.

Esposito, M., Tse, T., & Soufani, K. (2018). Introducing a circular economy: New thinking with new managerial and policy implications. *California Management Review, 60*(3), 5–19.

Evans, S., Gregory, M., Ryan, C., Bergendahl, M. N., & Tan, A. (2009). *Towards a sustainable industrial system with recommendations for education, research, industry and policy*. University of Cambridge, Institute for Manufacturing. Retrieved from https://backend.orbit.dtu.dk/ws/portalfiles/portal/4085316/industrial_sustainability_report.pdf.

Farooque, M., Zhang, A., Thürer, M., Qu, T., & Huisingh, D. (2019). Circular supply chain management: A definition and structured literature review. *Journal of Cleaner Production, 228*, 882–900.

Fehrer, J. A., & Wieland, H. (2020). A systemic logic for circular business models. *Journal of Business Research, 125*, 609–620.

Ferasso, M., Beliaeva, T., Kraus, S., Clauss, T., & Ribeiro-Soriano, D. (2020). Circular economy business models: The state of research and avenues ahead. *Business Strategy and the Environment, 29*(8), 3006–3024.

Flick, U. (2004). Triangulation in qualitative research. In U. Flick, E. von Kardorff, & I. Steinke (Eds.), *A companion to qualitative research* (3rd ed., pp. 178–183). London: SAGE.

Franzò, S., Urbinati, A., Chiaroni, D., & Chiesa, V. (2021). Unravelling the design process of business models from linear to circular: An empirical investigation. *Business Strategy and the Environment, 30*(6), 2758–2772.

Frostenson, M., & Prenkert, F. (2014). Sustainable supply chain management when focal firms are complex: A network perspective. *Journal of Cleaner Production, 107*, 85–94.

Geissdoerfer, M., Morioka, S. N., de Carvalho, M. M., & Evans, S. (2018). Business models and supply chains for the circular economy. *Journal of Cleaner Production, 190*, 712–721.

Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production, 114*, 11–32.

Gilbert, P., Wilson, P., Walsh, C., & Hodgson, P. (2017). The role of material efficiency to reduce $CO_2$ emissions during ship manufacture: A life cycle approach. *Marine Policy, 75*, 227–237.

González-Sánchez, R., Settembre-Blundo, D., Ferrari, A. M., & García-Muiña, F. E. (2020). Main dimensions in the building of the circular supply chain: A literature review. *Sustainability (Switzerland), 12*(6), 1–25.

Govindan, K., & Hasanagic, M. (2018). A systematic review on drivers, barriers, and practices towards circular economy: A supply chain perspective. *International Journal of Production Research, 56*(1–2), 278–311.

Guide, V. D. R., & Van Wassenhove, L. N. (2009). The evolution of closed-loop supply chain research. *Operations Research, 57*(1), 10–18.

Haneef, M., Nasir, A., Genovese, A., Acquaye, A. A., Koh, S. C. L., & Yamoah, F. (2016). Comparing linear and circular supply chains: A case study from the construction industry. *International Journal of Production Economics, 183*, 443–457.

Hazen, B. T., Russo, I., Confente, I., & Pellathy, D. (2020). Supply chain management for circular economy: Conceptual framework and research agenda. *International Journal of Logistics Management, 32*(2), 510–537.

Hussain, M., & Malik, M. (2020). Organizational enablers for circular economy in the context of sustainable supply chain management. *Journal of Cleaner Production, 256*, Article 120375.

Ingstrup, M. B., Aarikka-Stenroos, L., & Adlin, N. (2021). When institutional logics meet: Alignment and misalignment in collaboration between academia and practitioners. *Industrial Marketing Management, 92*, 267–276.

Inigo, E. A., Ritala, P., & Albareda, L. (2020). Networking for sustainability: Alliance capabilities and sustainability-oriented innovation. *Industrial Marketing Management, 89*, 550–565.

Julianelli, V., Caiado, R. G. G., Scavarda, L. F., & de Cruz, S. P. M. F. (2020). Interplay between reverse logistics and circular economy: Critical success factors-based taxonomy and framework. *Resources, Conservation and Recycling, 158*, Article 104784.

Kaipainen, J., & Aarikka-Stenroos, L. (2021). From vision to commercialization of a circular economy innovation – A longitudinal study of overcoming challenges throughout the full innovation process. In S. Jakobsen, T. A. Lauvås, M. T. Steinmo, E. A. Rasmussen, & F. Quatraro (Eds.), *Handbook of innovation for circular economy* (pp. 59–71). Edward Elgar Publishing.

Kaipainen, J., & Aarikka-Stenroos, L. (2022). How to renew business strategy to achieve sustainability and circularity? A process model of strategic development in incumbent technology companies. In *Business Strategy and the Environment, Online First Edition*. https://doi.org/10.1002/bse.2992

Khitous, F., Strozzi, F., Urbinati, A., & Alberti, F. (2020). A systematic literature network analysis of existing themes and emerging research trends in circular economy. *Sustainability (Switzerland), 12*(4), 1633.

Khitous, F., Urbinati, A., & Verleye, K. (2022). Product-service systems: A customer engagement perspective in the fashion industry. *Journal of Cleaner Production, 336*, Article 130394.

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling, 127*, 221–232.

Kjaer, L. L., Pigosso, D. C. A., Niero, M., Bech, N. M., & McAloone, T. C. (2019). Product/service-systems for a circular economy: The route to decoupling economic growth from resource consumption? *Journal of Industrial Ecology, 23*(1), 22–35.

Lacy, P., & Rutqvist, J. (2016). *Waste to wealth: The circular economy advantage*. London: Springer.

Lahane, S., Kant, R., & Shankar, R. (2020). Circular supply chain management: A state-of-art review and future opportunities. *Journal of Cleaner Production, 258*, Article 120859.
Lapko, Y., Trianni, A., Nuur, C., & Masi, D. (2019). In pursuit of closed-loop supply chains for critical materials: An exploratory study in the green energy sector. *Journal of Industrial Ecology, 23*(1), 182–196.
Lieder, M., Asif, F. M. A., & Rashid, A. (2017). Towards circular economy implementation: An agent-based simulation approach for business model changes. *Autonomous Agents and Multi-Agent Systems, 31*(6), 1377–1402.
Linder, M., & Williander, M. (2017). Circular business model innovation: Inherent uncertainties. *Business Strategy and the Environment, 26*(2), 182–196.
Liu, J., Feng, Y., Zhu, Q., & Sarkis, J. (2018). Green supply chain management and the circular economy: Reviewing theory for advancement of both fields. *International Journal of Physical Distribution and Logistics Management, 48*(8), 794–817.
Lüdeke-Freund, F., Gold, S., & Bocken, N. M. P. (2019). A review and typology of circular economy business model patterns. *Journal of Industrial Ecology, 23*(1), 36–61.
Mangla, S. K., Luthra, S., Mishra, N., Singh, A., Rana, N. P., Dora, M., & Dwivedi, Y. (2018). Barriers to effective circular supply chain management in a developing country context. *Production Planning and Control, 29*(6), 551–569.
Maranesi, C., & De Giovanni, P. (2020). Modern circular economy: Corporate strategy, supply chain, and industrial symbiosis. *Sustainability (Switzerland), 12*(22), 1–25.
Marconi, M., Germani, M., Mandolini, M., & Favi, C. (2019). Applying data mining technique to disassembly sequence planning: A method to assess effective disassembly time of industrial products. *International Journal of Production Research, 57*(2), 599–623.
Masi, D., Day, S., & Godsell, J. (2017). Supply chain configurations in the circular economy: A systematic literature review. *Sustainability (Switzerland), 9*(9), 1602.
Mendoza, J. M. F., Sharmina, M., Gallego-Schmid, A., Heyes, G., & Azapagic, A. (2017). Integrating backcasting and eco-design for the circular economy: The BECE framework. *Journal of Industrial Ecology, 21*(3), 526–544.
Merli, R., Preziosi, M., & Acampora, A. (2017). How do scholars approach the circular economy? A systematic literature review. *Journal of Cleaner Production, 178*, 703–722.
Mishra, J. L., Hopkinson, P. G., & Tidridge, G. (2018). Value creation from circular economy-led closed loop supply chains: A case study of fast-moving consumer goods. *Production Planning and Control, 29*(6), 509–521.
Moreno, M., Court, R., Wright, M., & Charnley, F. (2018). Opportunities for redistributed manufacturing and digital intelligence as enablers of a circular economy. *International Journal of Sustainable Engineering, 12*(2), 77–94.
Murray, A., Skene, K., & Haynes, K. (2017). The circular economy: An interdisciplinary exploration of the concept and application in a global context. *Journal of Business Ethics, 140*(3), 369–380.
Närvänen, E., Mattila, M., & Mesiranta, N. (2021). Institutional work in food waste reduction: Start-ups' role in moving towards a circular economy. *Industrial Marketing Management, 93*, 605–616.
Niero, M., & Hauschild, M. Z. (2017). Closing the loop for packaging: Finding a framework to operationalize circular economy strategies. *Procedia CIRP, 61*, 685–690.
Patton, M. Q. (2005). Qualitative research. In *Encyclopedia of statistics in behavioral science*. New Jersey: Wiley. https://doi.org/10.1002/0470013192.bsa514.
Pomponi, F., & Moncaster, A. (2016). Circular economy for the built environment: A research framework. *Journal of Cleaner Production, 143*, 710–718.
Press, M., Robert, I., & Maillefert, M. (2019). The role of linked legitimacy in sustainable business model development. *Industrial Marketing Management, 89*, 566–577.
Ranta, V., Aarikka-Stenroos, L., & Mäkinen, S. J. (2018). Creating value in the circular economy: A structured multiple-case analysis of business models. *Journal of Cleaner Production, 201*, 988–1000.
Ranta, V., Keränen, J., & Aarikka-Stenroos, L. (2020). How B2B suppliers articulate customer value propositions in the circular economy: Four innovation-driven value creation logics. *Industrial Marketing Management, 87*, 291–305.
Reichertz, J. (2004). Abduction, deduction and induction in qualitative research. In U. Flick, E. von Kardoff, & I. Steinke (Eds.), *A companion to qualitative research* (pp. 159–164). London: SAGE.
Reim, W., Parida, V., & Ortqvist, D. (2014). Product–service systems (PSS) business models and tactics–a systematic literature review. *Journal of Cleaner Production, 97*, 61–75.
Ritter, T., Wilkinson, I. F., & Johnston, W. J. (2004). Managing in complex business networks. *Industrial Marketing Management, 33*(3), 175–183.
Rosa, P., Sassanelli, C., Urbinati, A., Chiaroni, D., & Terzi, S. (2020). Assessing relations between circular economy and industry 4.0: A systematic literature review. *International Journal of Production Research, 58*(6), 1662–1687.
Sassanelli, C., Urbinati, A., Rosa, P., Chiaroni, D., & Terzi, S. (2020). Addressing circular economy through design for X approaches: A systematic literature review. *Computers in Industry, 120*, Article 103245.
Scheepens, A. E., Vogtl, J. G., & Brezet, J. C. (2015). Two life cycle assessment (LCA) based methods to analyse and design complex (regional) circular economy systems. Case: Making water tourism more sustainable. *Journal of Cleaner Production, 114*, 257–268.
Schwanholz, J., & Leipold, S. (2020). Sharing for a circular economy? An analysis of digital sharing platforms' principles and business models. *Journal of Cleaner Production, 269*, Article 122327.
Sehnem, S., Vazquez-Brust, D., Pereira, S. C. F., & Campos, L. M. S. (2019). Circular economy: Benefits, impacts and overlapping. *Supply Chain Management, 24*(6), 784–804.
Shao, J., & Ünal, E. (2019). What do consumers value more in green purchasing? Assessing the sustainability practices from demand side of business. *Journal of Cleaner Production, 209*, 1473–1483.
Sharma, A. (2020). Sustainability research in business-to-business markets: An agenda for inquiry. *Industrial Marketing Management, 88*, 323–329.
Singh, J., & Ordoñez, I. (2016). Resource recovery from post-consumer waste: Important lessons for the upcoming circular economy. *Journal of Cleaner Production, 134*, 342–353.
Smieja, J. M., & Babcock, K. E. (2017). The intersection of green chemistry and Steelcase's path to circular economy. *Green Chemistry Letters and Reviews, 10*(4), 331–335.
de Sousa Jabbour, A. B. L., Jabbour, C. J. C., Godinho Filho, M., & Roubaud, D. (2018). Industry 4.0 and the circular economy: A proposed research agenda and original roadmap for sustainable operations. *Ann. Oper. Res., 270*(1), 273–286.
Sousa-Zomer, T. T., Magalhães, L., Zancul, E., & Cauchick-Miguel, P. A. (2017). Exploring the challenges for circular business implementation in manufacturing companies: An empirical investigation of a pay-per-use service provider. *Resources, Conservation and Recycling, 135*, 3–13.
Tukker, A. (2015). Product services for a resource-efficient and circular economy–a review. *Journal of Cleaner Production, 97*, 76–91.
Tukker, A., & Tischner, U. (2006). Product-services as a research field: Past, present and future. Reflections from a decade of research. *Journal of Cleaner Production, 14*(17), 1552–1556.
Tura, N., Hanski, J., Ahola, T., Ståhle, M., Piiparinen, S., & Valkokari, P. (2018). Unlocking circular business: A framework of barriers and drivers. *Journal of Cleaner Production, 212*, 90–98.
Ünal, E., Urbinati, A., & Chiaroni, D. (2019). Managerial practices for designing circular economy business models: The case of an Italian SME in the office supply industry. *Journal of Manufacturing Technology, 30*(3), 561–589.
Ünal, E., Urbinati, A., Chiaroni, D., & Manzini, R. (2019). Value creation in circular business models: The case of a US small medium enterprise in the building sector. *Resources, Conservation and Recycling, 146*, 291–307.
Urbinati, A., Chiaroni, D., & Chiesa, V. (2017). Towards a new taxonomy of circular economy business models. *Journal of Cleaner Production, 168*, 487–498.
Urbinati, A., Chiaroni, D., & Toletti, G. (2019). Managing the introduction of circular products: Evidence from the beverage industry. *Sustainability (Switzerland), 11*(13), 1–12.
Vermeulen, W. J. V. (2015). Self-governance for sustainable global supply chains: Can it deliver the impacts needed? *Business Strategy and the Environment, 24*(2), 73–85.
Vlajic, J. V., Mijailovic, R., & Bogdanova, M. (2018). Creating loops with value recovery: Empirical study of fresh food supply chains. *Production Planning and Control, 29*(6), 522–538.
Witjes, S., & Lozano, R. (2016). Towards a more circular economy: Proposing a framework linking sustainable public procurement and sustainable business models. *Resources, Conservation and Recycling, 112*, 37–44.
Yang, M., Smart, P., Kumar, M., Jolly, M., & Evans, S. (2018). Product-service systems business models for circular supply chains. *Production Planning and Control, 29*(6), 498–508.
Zhang, J. Z., & Watson, G. F., IV (2020). Marketing ecosystem: An outside-in view for sustainable advantage. *Industrial Marketing Management, 88*, 287–304.
Zhu, Q., Sarkis, J., & Lai, K. H. (2008). Green supply chain management implications for "closing the loop". *Transportation Research Part E: Logistics and Transportation Review, 44*(1), 1–18.
Zucchella, A., & Previtali, P. (2019). Circular business models for sustainable development: A "waste is food" restorative ecosystem. *Business Strategy and the Environment, 28*(2), 274–285.