THESIS FOR THE DEGREE OF LICENTIATE OF ENGINEERING

Business networks in circular supply chains

Understanding interactions, tensions, and collaborations

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Abstract

Circular supply chains (CSCs) involve diverse patterns of collaboration and experience tensions that differ from those in traditional linear supply chains. Considering that the nature of circularity is preserving the value of products and materials over the long run, the collaboration and interaction of the firms in their business network change. This change is not just an extension of the linear supply chains but represent new characteristics that require closer attention, since circularity emerges through the business networks in CSCs. Firms do not achieve circularity in isolation; it is developed through interaction in networks where various actors with diverse roles and interests contribute to and negotiate the direction of change.

This thesis aims to explore how business networks contribute to the transition towards CSCs, with the role of interaction, collaboration, and tensions in focus. As more firms shift away from linear to circular approaches, they also encounter not only technical and operational tensions but also a multitude of other tensions, such as relational tensions that unfold over time, between organizations, and in the larger networks.

The thesis builds on the combined findings of two papers, both of which examine how business networks are involved in the development of CSCs. Both of the studies in the two papers are focused on organizing circularity at the firm, dyadic, and network levels, revealing the complexity of transition into a CSC. The thesis considers the evolution of CSCs as a dynamic process where the firms and other actors often face tensions and need collaboration to adapt over time to make circular solutions possible. These tensions can be productive, and pressure points develop into opportunities. They also open up space for conversation and rethink the routines of actors, and test new forms of collaboration within the network, which can help CSCs develop and improve.

By addressing the three research questions, the thesis contributes theoretically by elaborating the networked nature of CSCs, offering a processual multi-level perspective, identifying key tensions and related collaboration strategies, and adopting a business network and a processual perspective drawing on the industrial network approach.

Keywords: Circular economy, circular supply chains, interactions, tensions, collaboration, business networks, sustainability

List of appended papers

Paper I

Emad, M.; Govik, L.; Arvidsson, A. Overcoming tensions in circular supply chains through collaborative networks

An earlier version of the paper was presented at the 39th IMP and the 33rd International IPSERA conferences.

Contribution: Main author; main responsible for conceptualization, data collection, and analysis, main part of the interpretation, writing of the paper, and responding to the review process.

Paper II

Emad, M.; Arvidsson, A.; Govik, L. Interactions in business networks on the journey towards circularity

An earlier version of the paper was presented at the 34th NOFOMA and the 31st EurOMA conferences.

Contribution: Main author; main responsible for conceptualization, data collection and analysis, main part of the interpretation, writing of the paper, and responding to the review process.

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This thesis marks a halfway point in my PhD journey, and the experience has taught me a great deal, not only academically and for gaining specialized knowledge in a field, but also personally, to develop a range of personal and professional skills. These are lessons that extend far beyond the thesis itself and continue to shape how I think and work. In this journey, I have been fortunate to be surrounded by people, both within academia and outside it, whose encouragement and presence have helped me stay grounded and move forward. This is a small attempt to thank them.

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Mandana Emad
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Table of Contents

List of tables

List of figures

Abbreviations

CSC	Circular supply chain
INA	Industrial network approach
CE	Circular economy
CBM	Circular business model

1. Introduction

This chapter introduces the thesis by outlining the broader context and motivations behind the study. It begins with a background to the research and situating the work within the current literature on business networks in circular supply chains (CSCs). The chapter then outlines the research purpose and the research questions of this thesis. Together, these sections establish the foundation for the study and clarify its contribution to ongoing discussions on the transition to CSCs.

1.1. Background

Sustainability concerns are pushing firms and industries to adopt circular economy (CE) principles, leading to increased interest in transitioning linear supply chains into CSCs (Harrison *et al.*, 2023, Keränen *et al.*, 2023, Do *et al.*, 2024). This shift requires companies to fundamentally rethink their supply chain operations and to engage in new forms of collaboration across business networks (Farooque *et al.*, 2019b, Sudusinghe and Seuring, 2022). Achieving circularity is a systemic challenge that demands alignment and coordination beyond the efforts of any single firm, extending across the entire network of actors (Marques and Manzanares, 2022, Rizos *et al.*, 2016). As a result, many firms are now attempting to transition to CSCs, designed to recirculate products and materials, thereby minimizing waste and environmental impact (Batista *et al.*, 2018, Farooque *et al.*, 2019a). By linking the different actors together, CSCs have the potential to improve economic, environmental, and social sustainability outcomes for the network as a whole (Batista *et al.*, 2019, Geissdoerfer *et al.*, 2018).

Implementing CE principles in a supply chain context inherently involves multiple organizations, since no firm can achieve circularity in isolation (Rizos *et al.*, 2016). For instance, remanufacturing a product requires collaboration between producers, service partners, and logistics providers to return and restore used components (Batista *et al.*, 2018). Instead of straightforward dyadic buyer-supplier transactions, CSCs encompass business networks of interdependent actors, from manufacturers and suppliers to customers, recyclers, regulators, and innovation partners, who must interact and collaborate to enable circular flows (De Angelis *et al.*, 2018, Leising *et al.*, 2018). Prior studies indicate that firms embracing circular innovations frequently bring new partners into their business network and adapt existing relationships (Aarikka-Stenroos *et al.*, 2022). Collaboration between the firms provides access to complementary resources and knowledge, enabling activities like product take-back, remanufacturing, or industrial symbiosis that a single firm could not perform alone (Lieder and Rashid, 2016, Melander and Pazirandeh, 2019). This reflects the importance of taking a system thinking perspective when studying CSCs, not as actions of single firms, but as something that develops through relationships between multiple actors as a part of broader systems that include economic, social, and environmental dimensions and that their actions influence and are influenced by others in the system (Meadows and Wright, 2009). In this thesis, systems thinking is used at the micro-level, meaning that the focus is on how firms work together with their customers, suppliers, and other actors to move toward circularity.

Despite growing recognition of the importance of inter-organizational collaboration for CE implementation, several knowledge gaps remain. Much of the extant research on CE in supply chains has focused on identifying drivers and barriers to adoption at the firm level (de Jesus and Mendonça, 2018, Garcés-Ayerbe *et al.*, 2019) or on developing frameworks for circular business models (CBMs) and strategies (Bocken *et al.*, 2014, Hofmann and Jaeger-Erben, 2020). Far less attention has been paid to the process of how business networks actually transition from linear to circular practices over time. In particular, a deeper understanding is needed of how interactions within and between organizations evolve to trigger and sustain the shift to circularity (Sairanen *et al.*, 2024, Kanda *et al.*, 2024). Several studies have pointed to the importance of business network interactions in enabling circular transitions (Aarikka-Stenroos *et al.*, 2022, Franzò and Urbinati, 2023), yet detailed empirical insights into how these interactions unfold, for example, how firms initiate new partnerships, adjust their roles, or integrate new knowledge, are lacking (Keränen *et al.*, 2023, Harrison *et al.*, 2023). As firms depend on resources controlled by others, significant change (such as moving to a circular model) will involve reconfiguring relationships and activities across the network (Håkansson and Snehota, 1995, Gadde *et al.*, 2003). However, the nature and nuances of this network transition in a CE context have not been fully explored in prior research.

Additionally, the path towards CSC can reveal several tensions between network actors. Firms have to reconcile different goals as well as contradictory requirements, such as the pursuit of environmental goals with profitability or quality of their products (Daddi *et al.*, 2019, Dagilienė and Varaniūtė, 2023). New circular initiatives can strain inter-firm relationships, leading to tensions over resource sharing, control, or misaligned expectations between actors (Fang *et al.*, 2011, Chizaryfard *et al.*, 2022). These tensions provide a valuable analytical lens for understanding how different actors navigate conflicting goals and how outcomes and consequences manifest in multi-actor collaborative networks (Burton *et al.*, 2016). Different actors experience challenges in CSCs differently and how an actor sees and deals with tensions depends on what risks they perceive, what resources they have, and what new opportunities they see (Chizaryfard *et al.*, 2022). Prior studies suggest that if these tensions are managed constructively, they can become motivators for innovation, prompting firms to rethink routines and develop creative solutions (Brix-Asala *et al.*, 2018, Bradford *et al.*, 2004). Collaboration often serves as a key mechanism for addressing tensions in CSCs, since no single firm can resolve these challenges alone (Aarikka-Stenroos *et al.*, 2022). However, there is limited understanding of how these tensions emerge and are navigated in the context of the CSC transition process. In particular, research has yet to explain how collaboration within a business network both gives rise to and helps alleviate tensions as CSCs evolve. This gap, centered on the dynamic interplay between collaboration and tension in CSC transitions motivates the focus of this thesis.

1.2. Purpose and research questions

The purpose of this licentiate thesis is to generate knowledge on how business networks contribute to the transition toward CSCs. In other words, the thesis seeks to deepen the understanding of how interactions, collaborations, and tensions within business networks shape

and affect the transition from linear to CSCs. To address this purpose, the study is guided by the following three research questions:

RQ1: *How can CSCs be characterized?*

This question seeks to identify the defining features of CSCs, clarifying how these circular characteristics differ from linear supply chains. Establishing such a characterization is important by clarifying what constitutes a CSC, allowing researchers, businesses, and policymakers to standardize the concept, and making it easier to analyze, implement, and study them more effectively.

RQ2: *How are CSCs developed over time?*

This question examines how CSCs evolve as they transition from linear to circular, focusing on changes in interactions and relationships over time. This focus is crucial because it addresses the lack of understanding of the dynamic and processual nature of circular transitions. This question highlights how interactions, relationships, and structures evolve across firm, dyadic, and network levels over time.

RQ3: *What tensions arise among network actors in the pursuit of CE initiatives, and how are these tensions collaboratively addressed?*

This question addresses the tensions that arise when firms pursue circularity in a network, as conflicting objectives and uncertainties make tension an inherent part of the transition, and investigates how such tensions can be overcome through collaboration among network actors. By identifying the types of tensions that occur and how actors jointly address them, RQ3 tackles the challenge during the circular transition. It also contributes to theory by uncovering collaborative network mechanisms that enable business networks to manage tensions in the pursuit of CSCs. Combining both aspects into one integrated question allows the study to trace the relationship between cause (tension) and response (collaboration), reflecting the processual and interactional logic of business network change (Grimm *et al.*, 2024, Aarikka-Stenroos *et al.*, 2022, Håkansson and Snehota, 1995). Figure *1* presents an overview of research questions, theoretical framework, and empirical context

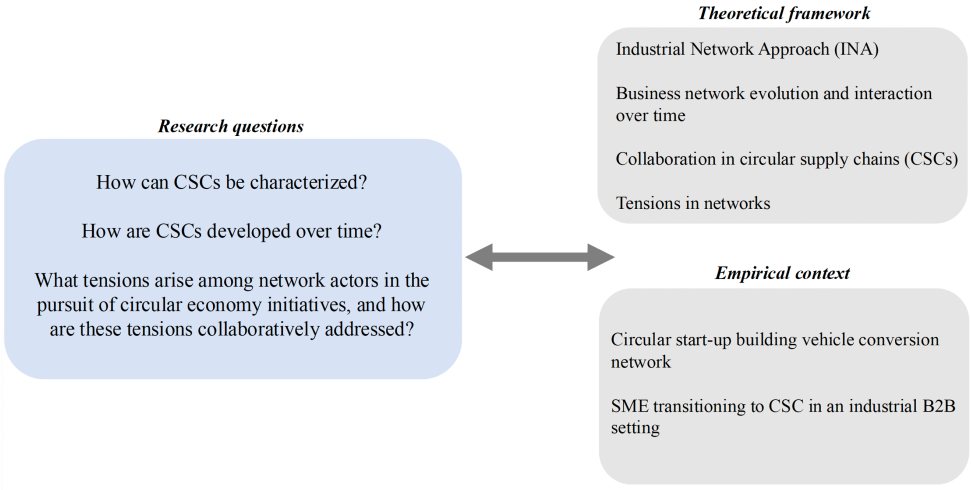

Figure 1. An overview of the research questions, theoretical framework, and context

1.3. Thesis outline

This thesis is structured as follows. Chapter 2 outlines the theoretical framework included in this thesis. Chapter 3 presents the research methodology. Chapter 5 discusses the findings in relation to the research questions and theoretical perspectives. Chapter 6 concludes with the study's theoretical contributions, managerial and policy implications, limitations, and suggestions for future research.

2. Theoretical framework

This chapter outlines the theoretical foundation of the thesis and presents the key conceptual streams that guide the analysis. To guide the reader through the Theoretical framework, Figure *2* outlines the key streams. The thesis focuses on the intersection of these streams, with a focus on the evolution of CSCs, the role of networked interactions, and the tensions that arise and are managed through different forms of collaboration. The selected streams of literature support the overall purpose of the thesis, which is to contribute to the understanding of how business networks contribute to the transition towards CSCs and deepen the understanding of how interactions, collaborations, and tensions within business networks shape and affect this transition.

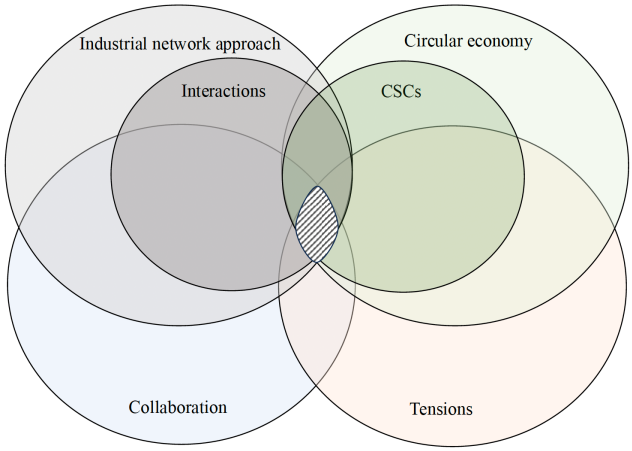

Figure 2. An overview of the conceptual focus areas of the thesis and their interrelations

2.1. The industrial network approach

According to the industrial network approach (INA), business relationships and networks are important for firms (Håkansson and Snehota, 2017). A central framework within INA is the ARA model (Håkansson and Snehota, 1995) which consists of actors, resources, and activities. Business networks consist of a diverse set of actors, such as customers, suppliers, users, intermediaries, governments, NGOs, and other organizations (Melander and Pazirandeh, 2019, Baraldi *et al.*, 2011). Within these networks, actors form links between individuals. Actors may take different roles, which change over time when the network develops.

Resources can be physical such as a factory or equipment, or they can be intangible such as knowledge (Sundquist and Melander, 2020). Resources can be adapted and integrated as interaction between actors develops. A resource does not exist in isolation but tends to be embedded in other resources, such as technical and organizational resources (Grönberg and Hulthén, 2022). Within INA, resources are often discussed in combination with interfaces, which are conceptualized as the touchpoints between actors' resources (Araujo *et al.*, 1999). One such interface is that between buyer and suppliers, which is important in product development for actors to share knowledge (Andersen and Gadde, 2019, Ferreira and Lind, 2022).

Actors perform many different activities, such as production, logistics, administration, deliveries, information handling, services, technology development, and other activities. How activities are organized, how resources are adapted, and which actors are included are described through interactions (Guercini *et al.*, 2014). As no single firm controls all resources needed to perform all necessary activities to operate its business, actors are dependent on other actors in the network and need to interact with them (Gadde *et al.*, 2003, Håkansson *et al.*, 2009). Interaction is also an important aspect when developing business models (Håkansson and Waluszewski, 2013, Bankvall *et al.*, 2017). Business relationships are very important to younger firms such as start-ups (Landqvist and Lind, 2019, La Rocca and Snehota, 2021). Developing networks is crucial for start-ups that rely on initial customer relationships to become reference customers, provide feedback, and provide legitimacy (Aaboen *et al.*, 2011, Baraldi *et al.*, 2019, Laage-Hellman *et al.*, 2018). INA studies also point to the importance of supplier networks for start-ups (La Rocca and Snehota, 2021). Start-ups that are providing new innovative solutions to be implemented in a wide network, such as the transport network, need to collaborate with regulatory and governmental actors to be able to test their innovations in public settings (Melander and Lind, 2022).

2.1.1. Interactions

INA positions interaction, a foundational concept that describes the mutual processes through which firms engage with each other over time by exchanging resources, coordinating activities, and building social relationships, as a foundational concept for understanding business markets (Håkansson and Snehota, 1995, Håkansson, 1982). Rather than viewing exchanges as discrete transactions, INA scholars argue that firms are embedded in ongoing interaction processes that shape business relationships and networks (Ford and Håkansson, 2006, Håkansson and Snehota, 1995). Through such interactions, companies mutually adapt, develop interdependencies, and co-create value, implying that what a firm can achieve depends not only on its own resources but also on its network of relationships (Gadde and Snehota, 2019).

Interactions occur at multiple levels within firms, between firms (dyad), and across broader networks (Melander and Arvidsson, 2021). Individuals at similar organizational levels in different firms can develop greater mutual understanding with each other than with colleagues at different levels in their own firm, underscoring how cross-company interaction may bridge internal divides in practice (Öberg, 2010). In the context of CSCs, interaction is especially pivotal because transitioning from linear to circular models requires intensive coordination among multiple actors (Farooque *et al.*, 2019b). At the firm level, managers engage in networking activities to deliberately handle external relationships, integrating interaction into their strategy and operations (Ford and Redwood, 2005). At the dyadic level of buyer-supplier relationships, repeated interactions build trust, align activities and enable joint problem-solving (Gadde and Snehota, 2019). At the network level, interaction is a continuous process encompassing many actors.

Business networks consist of numerous interconnected actors whose interactions collectively shape the network's structure and evolution (Baraldi et al., 2011, Melander and Arvidsson, 2020). Implementing a new sharing-focused business model in an industrial company

demanded novel interaction patterns internally and externally, while partnerships with new actors and stronger collaboration with existing ones have also been identified as critical for enabling circular business practices (Melander and Arvidsson, 2021). Interactions in one relationship can ripple through others, so that no exchange is truly isolated in a network. Interactions are also cumulative and prior exchanges set the context for future collaboration among actors (Baraldi et al., 2011). This interactive, multi-level engagement is what drives the co-creation, adaptation, and learning necessary for CSC innovations. The reality of network interaction often reshapes outcomes of major changes or innovations which may require bringing in new partners and altering existing relationships (Öberg, 2019). In line with this, more radical shifts like a transition to a CSC typically cannot be achieved by a single firm alone, they emerge through continuous interaction within the network of actors involved (Baraldi *et al.*, 2019, Melander and Arvidsson, 2021). Thus, interaction remains a central concept in business networks, underpinning how firms jointly negotiate change and progress toward circularity in supply chains.

2.2. Collaboration

Collaboration as the joint efforts of two or more independent firms to plan and execute supply chain operations more effectively than if they acted alone (Simatupang and Sridharan, 2002) has evolved from focusing on simple dyadic relationships to encompassing a broader network that includes external organizations such as research institutes, government agencies, and training bodies (Liao *et al.*, 2017) in a CSC. Involving both internal and external actors can improve sustainability and operational performance, even though the primary goals of CSC collaboration are environmental and economic (Sudusinghe and Seuring, 2021).

Collaboration is a multifaceted concept that extends beyond the mere sharing of information or resources; it is a relationship-driven process that emphasizes the importance of fostering strong, long-term partnerships and enables organizations to align their objectives, combine their strengths, and work towards mutually beneficial outcomes (Soosay and Hyland, 2015, Stank *et al.*, 2001). These partnerships go beyond transactional interactions and are characterized by a shared commitment to value creation, where partners are willing to adapt to changing market conditions and engage in open, transparent communication to drive continuous improvement and maximize collective success (Marqui *et al.*, 2013). Collaboration involves the sharing of ideas, information, knowledge, risks, and rewards among all supply chain partners (Singh *et al.*, 2016, Singh *et al.*, 2020). Numerous benefits arise from effective partnerships and collaboration in supply chains, such as reduced costs, increased sales, improved customer service, and enhanced competitiveness (Bratton *et al.*, 2000). Deeper, proactive supplier engagement (Brix-Asala *et al.*, 2018) can help to overcome challenges that networked relationships present, such as the need for trust, goal alignment, and effective communication. A key dimension of supply chain collaboration that has a close correlation with trust is information sharing (Virata, 2013). While trust positively influences information sharing and collaborative activities between supply chain partners (Panahifar *et al.*, 2018), it could also be a frequent source of friction and its management becomes more challenging, especially in complicated, multi-actor networked supply chains. Companies need to form long-

term, transparent partnerships where rewards and risks are distributed fairly in order to foster trust (Bankel and Govik, 2024). This necessitates a collaborative approach to setting mutual goals, open communication channels, and shared decision-making processes.

There has been a growing body of literature examining collaboration within the frameworks of sustainability and environmental management (Sudusinghe and Seuring, 2022) and a more limited, yet emerging set of research focuses on collaboration in the context of the CE (Batista *et al.*, 2018) and importance of collaboration in the integration of advanced technologies in transitioning to CBMs (Toth-Peter *et al.*, 2023). Collaboration in supply chains is seen as one of the important attributes of the CSCs (Vlajic *et al.*, 2018). CSCs emphasize resource efficiency, incorporating practices like reuse, recycling, and remanufacturing to minimize waste and extend product life cycles (Geissdoerfer *et al.*, 2017). Collaboration practices such as information sharing, joint product design, risk-sharing, and partnerships with external actors are essential for integrating circularity into supply chain operations and improving sustainability performance (Fischer and Pascucci, 2017). De Angelis *et al.* (2018) stress that collaboration allows multiple actors, suppliers, manufacturers, and recyclers, to pool resources and expertise, thus enabling the shift from linear to circular models of production and consumption and is one of the key pillars of the CE and CSCs.

2.3. Circular economy

The idea of circularity has received a lot of attention lately since it provides a way to tackle environmental issues while simultaneously generating business potential (Geissdoerfer *et al.*, 2020). Based on 114 definitions of CE, (Kirchherr *et al.*, 2017) describe it as an economic system that attempts to encourage new ways of doing business and promoting sustainable practices among consumers, to create a better future for everyone. The ultimate goal of the CE is to create a sustainable economy that maximizes the usage and value of the resource while reducing waste and minimizing the negative environmental impact of production and consumption which may be accomplished through automation, exchanging alternatives, designing durable products, preserving them, repairing and renovating them, upcycling, reusing, and recycling them (Geissdoerfer *et al.*, 2020). By making efficient use of residuals, the CE seeks to detach economic evolution from resource limitations (Ellen MacArthur, 2013). This strategy can lessen the negative effects of corporate operations on the environment while fostering a more resilient and sustainable economy (Winkler, 2011).

Studies have investigated the variables driving and hindering firms from adopting CE practices and it has been discovered that the most proactive businesses frequently deal with similar challenges like administrative challenges, legal restrictions, and a shortage of human resources (Garcés-Ayerbe *et al.*, 2019). Hard variables, such as technological availability and economic factors like capital requirements, as well as soft factors, such as social, regulatory, and institutional features, can be included in the drivers and barriers. Soft factors, particularly institutional framing, serve an important role in driving the CE process (de Jesus and Mendonça, 2018). The transition to CE involves collaboration of all the actors from upstream to downstream in the supply chain (Farooque *et al.*, 2019a, Batista *et al.*, 2018, Leising *et al.*, 2018).

2.3.1. Circular supply chains

To realize CE principles and operationalize them, firms must redesign their supply chains to CSCs to support restorative and regenerative cycles, and integrate CBMs (Vegter *et al.*, 2020). The literature's attention to CSCs has increased significantly in recent years, positioning it as an emerging area of research (Lahane *et al.*, 2020, Geissdoerfer *et al.*, 2018, Amir *et al.*, 2023). Nonetheless, conceptual overlaps remain with related fields such as reverse logistics, closed-loop systems, and life-cycle assessments, which continue to shape the discourse on circular practices in supply chains (Sehnem *et al.*, 2019). CSCs refer to the coordinated forward and reverse supply chains that enable value creation from products, by-products, and waste flows through extended life cycles, supporting economic, environmental, and social sustainability (Batista *et al.*, 2019).

Unlike isolated sustainability initiatives at the firm level, CSCs require coordinated change and collaboration across interconnected networks of actors, where alignment and joint action are necessary to generate and sustain circular outcomes (Marques and Manzanares, 2022). These networks often involve diverse actors, ranging from small firms and start-ups to large corporations, each contributing to different parts of the circular system (De Angelis *et al.*, 2018). Achieving circularity in such settings implies developing transparent, collaborative relationships and distributing value creation and benefits equitably among network actors (Leising *et al.*, 2018). The management of CSCs is often complex, involving not only the redesign of operational activities but also the coordination of multiple actors across networks, each with differing goals and capabilities (Braz and de Mello, 2023).

CSC development can also be understood as part of a broader supply chain transformation, where firms restructure not only processes but also relationships and interaction patterns in response to changing technological, market, or sustainability demands (Chakravarty, 2014). Over time, as supply chains became more complex and dynamic, interactions evolved to become more collaborative and technology-driven, enabling better coordination and responsiveness and the interaction between two or more actors along a supply chain must evolve accordingly (Chakravarty, 2014, Veile *et al.*, 2024). The journey toward adopting CSCs could also be driven by critical disruptions, as demonstrated during the global COVID-19 outbreak, making the CE an essential paradigm to study for its practical solutions to such crises (Hartley *et al.*, 2024). Ultimately, the transition toward CSCs requires a redefinition of how value is created, and how tensions and challenges are addressed through collaboration, adaptive learning, and long-term alignment across actors.

2.4. Tensions

The literature on organizational studies on change highlights that tensions, contradictions, and dilemmas are inherent in organizations, particularly during innovation and change (Smith *et al.*, 2017). These tensions are particularly relevant for CSCs, where the complexity of the network and the need for sustainability create both opportunities and challenges. Tensions are often perceived as challenges that arise from conflicting goals and interests among collaborating actors, leading to potential strain, conflict, or even the dissolution of business relationships and network partnerships and usually categorized broadly under structural,

psychological, and behavioral tensions each influencing different aspects of organizational dynamics and supply chain relationships (Fang *et al.*, 2011, Gnyawali *et al.*, 2016, Pressey and Vanharanta, 2016).

Scholars have examined businesses with a CE approach via the lens of paradox management as well (Daddi *et al.*, 2019, De Angelis, 2021). For example, in industries like the luxury leather sector, as discussed by Daddi *et al.* (2019), companies face an organizing paradox because they are expected to deliver high levels of creativity in design and innovation, which defines their luxury status, while also needing to remain efficient in terms of costs and operations to stay profitable. They also point to a performing paradox: the tension between the intensive use of secondary raw materials and product quality and profitability. This is high in premium markets where customers have high expectations, while perceived value is lower due to the use of recycled materials. According to these findings, the tension in the CSC has implications both for operational efficiency and market positioning, when firms try to balance the meeting of sustainability goals without sacrificing product quality (Dagilienė and Varaniūtė, 2023). Cristofaro *et al.* (2024) identify three central paradoxes in business networks: development of relationships versus inability to change, controlling versus effectiveness, and stability versus change. Commonly, these paradoxes reflect tensions in supply chain networks, where transitions into new models, such as CSCs, are in place. For example, in the process of building strong relationships within the network, companies have little room to maneuver in adapting to circular practices; hence, tension is created between maintaining existing relationships and pursuing new circular strategies.

Table 1. Literature review on tensions and collaborations in business networks

Paper	Perception of tensions	Examples of tensions	Example collaboration to overcome tension	Key lenses/approaches
Chizaryfard *et al.* (2022)	Tensions arise from both opportunities and challenges in transitioning to circular material systems (for the electric vehicle batteries case)	Structural tensions related to mining limitations, uneven development of reverse logistics, competition between European and Asian suppliers, and a lack of dominant technological design due to rapid changes in battery technologies.	Collaborations between mining companies, EV manufacturers, material producers, and recyclers to manage supply chains and CE goals.	Multi-actor perspective on structural tensions in industrial transitions.
Cristofaro *et al.* (2024)	Business network paradoxes are identified in three core areas: relationship development, control vs. effectiveness, and stability vs. change.	Tensions arise from interdependencies, misaligned objectives, balancing control with effectiveness in networks, resource misallocation, and weak coordinating norms	Co-evolutionary perspective suggests mutual adaptation and network capability development. Focus on moral behavior, structuration, and co-adaptation.	Co-evolutionary perspective, INA
Daddi *et al.* (2019)	Tensions arise from paradoxes between sustainability and competitiveness,	Using recycled materials can impact product competitiveness;	Collaboration in industrial symbiosis and with stakeholders helps manage CE tensions. Proactive	Paradox Theory (Organizatio

	particularly in CE business cases (paper production, textile/clothing, and leather)	balancing environmental commitments with market demands.	collaboration strategies across sectors are crucial to balance economic and environmental goals.	nal perspective)
Dagilienė and Varaniūtė (2023)	Paradoxical tensions between circularity and economic value, with strategic, temporal, and spatial dimensions.	Conflicts between environmental sustainability and economic objectives; compliance with complex regulations; innovation adoption challenges.	In-network collaboration, stakeholder engagement, and the use of paradox theory to manage competing demands.	Paradox theory, (strategic, temporal, and spatial paradoxes)
De Angelis (2021)	Organizational paradoxes during CE implementation.	Tensions between circularity and economic goals, short-term profitability versus long-term prosperity, competition versus collaboration.	Collaboration with value chain partners, balancing short-term and long-term goals, integrating circular innovation within business models.	Paradox theory, Network perspective
Farooque *et al.* (2019a)	Tensions are seen as "barriers" to circular adoption due to insufficient collaboration and weak regulatory frameworks (case of food supply chains)	Market reluctance to circular models, inadequate governmental support, market barriers, lack of collaboration among actors.	Emphasizes the need for greater collaboration between food processors, distributors, and consumers to overcome regulatory and market barriers, establish stronger inter-firm partnerships and engage regulators to create a supportive environment for circular practices.	Resource Dependence Theory, Institutional Theory, Stakeholder Theory
Hofmann and Jaeger-Erben (2020)	Organizational challenges in transitioning to CBMs.	Lack of internal alignment. institutional barriers and the tension between incremental adaptation and radical innovation, path dependency and structural inertia.	Collaboration with consultants to create strategies that enable firms to overcome the inertia of linear models and foster circular business transitions.	Not mentioned explicitly (transition management and CBM innovation)
Melander and Lind (2022)	Barriers to innovation adoption, including financial, technological, and regulatory issues.	Financial challenges, lack of infrastructure (charging), regulatory barriers, slow technological adoption.	Collaboration across micro, meso, and macro levels, including customers, government agencies, and energy providers. Integration of electric and autonomous vehicles.	Multi-level perspective (micro, meso, macro), Network perspective
Öberg *et al.* (2020)	Tensions in business networks arise from power imbalances, structural dependencies, and contradictions between collaboration and competition.	Structural tensions emerge when firms have conflicting strategic interests; relational tensions arise from trust issues and miscommunication; market tensions evolve due to changing competitive dynamics.	Tensions are managed through coalition-building, trust-based governance, and dynamic repositioning of firms within the network.	Paradox Theory, Network perspective

Tidström (2014)	Tensions inherent arise in coopetitive relationships due to simultaneous cooperation and competition.	Role conflicts, knowledge sharing, power and dependence, opportunism.	Trust and personal relationships reduce tensions; conflict management styles (competition, avoidance, collaboration) help manage tensions.	Conflict management theory (Thomas and Kilmann, 1974)
Tóth *et al.* (2018)	Tensions arise from network imbalance in value co-creation, particularly in communication networks.	Structural tensions from hierarchical communication networks, emotional tensions from miscommunication, and behavioral tensions from conflicting working styles	Informal communication networks and Social Balance Theory are used to manage and restore balance, with brokers playing a key role in mitigating tensions.	Social Balance Theory, Social Network Analysis
Tura *et al.* (2019)	Sustainability initiatives can create various tensions between business network actors.	Economic (investment costs, higher prices), structural (dependency on suppliers), psychological (motivation issues), and behavioral tensions (higher data collection requirements).	Collaboration through open communication, training, and integration efforts to align sustainability goals across the network. Also, promoting more inclusive and transparent network policies.	Tension perspective, network perspective, sustainable business practices (SBPs).

Tensions often surface in a consortium or collaborative partnership when partners try to balance the exploitation of existing resources with the exploration of new opportunities, or when attempting to innovate while maintaining stability (Haring *et al.*, 2023). These tensions are further compounded when firms attempt to push sustainability efforts within their network. Tura *et al.* (2019) show how different actors experience different tensions in the network due to focal firm sustainability efforts; suppliers experience a potential fear of being relegated to a lower tier supplier if the sustainability criteria are not met. Customers on the other hand fear increasing prices, decreasing performance or potential concerns with greenwashing and other network partners were concerned with added network complexity. Furthermore, these initiatives put additional pressure on supply chain partners to adjust their current practices, sometimes causing friction and necessitating coordinated adaptation (Hall, 2002, Kramer and Porter, 2006). Network tensions are interconnected and evolve as network configurations change, resolving one may inadvertently give rise to others, especially when new actors or activities are introduced (Öberg *et al.*, 2020).

Table 1 provides a detailed overview of selected literature on tensions in supply chains and collaborations, highlighting how different types of tensions were addressed through collaborative efforts with different lenses. This primary literature review helped the author to position this thesis within the existing body of work. While earlier studies identify various tensions, they often focus on broad sustainability challenges or there is no categorization of the distinct tensions that do not support actionable strategies. The table highlights the need for a more precise, multi-level understanding of tensions within business networks, particularly in CSCs, which this thesis aims to address. It thus helps clarify the research gap and justifies the study's conceptual and empirical focus.

3. Research methodology

This chapter discusses the methodology used in this thesis. It begins by describing the overall research design, case selection, research method and data collection, and research process and ends with reflecting on the research validity and reliability.

3.1. Research design

This thesis is based on two single in-depth empirical studies, each conducted in different contexts, one in a start-up-led network (pseudonym "Alpha"), and one in an established SME firm (pseudonym "TEMP"), but with a shared focus on how circularity is implemented in a networked supply chain through interactions and collaborations to enable theoretical replication and contrasting. Studying multiple cases allows the identification of patterns across different settings, strengthening the transferability of findings (Eisenhardt, 1989). To investigate the research questions, I employed a qualitative case study as it has an established relevance for studying organizations embedded in industrial networks (Easton, 2010, Gummesson, 2007). Social research can serve three primary purposes: exploration, description, and explanation (Babbie, 2009). In order to engage with a phenomenon that is both emergent and complicated, this thesis is primarily situated within an exploratory orientation that allows liberal and context-sensitive reasoning. Understanding why actors behave in certain ways requires interpreting their actions within the context in which they occur (Bryman and Bell, 2015). In this thesis, it was important to explore how firms and network actors perceive and respond to circularity-related challenges. A qualitative approach was therefore appropriate for capturing these situated meanings and interactions. This approach is relevant because the focus lies on an in-depth understanding of processes, meanings, and interactions, rather than quantifiable relationships.

The case study method is widely recognized for its capacity to capture interaction processes, especially where phenomena are embedded in networks of interdependent actors (Dubois & Araujo, 2005; Easton, 2010). Case studies are well-suited for studying "how" and "why" questions (Yin, 2018) in complex organizational contexts where boundaries between phenomenon and context are blurred and allow researchers to explore phenomena in a rich, real-world context when exploring how firms coordinate and reorganize supply chains to support circular goals (Eisenhardt and Graebner, 2007). This approach makes it possible to examine how relationships develop and how tensions are managed, both within organizations and spaces where different organizations interact, have friction, and collaborate. When studying business networks, it is not enough to focus only on one company or one relationship, as these parts are always connected to a wider context, and their meaning comes from how they are embedded in that network (Halinen and Törnroos, 2005).

In this thesis, I employed a processual approach to explore how change happens over time, relying on the broader stream of literature in process research (Langley *et al.*, 2013). In conducting this study, I applied a process-as-evolution approach (Grimm et al., 2024). I focused on tracing how interactions and relationships unfolded by following sequences of connected events and identifying the shifts that shaped the development of CSCs over time. This approach

could contribute to this study as it pays attention to interrelated activities and considers the turning points that, in this case, affect the evolution of CSCs. In attempting to understand how CSCs emerged and evolved over time, the collection of data entailed both past developments and current events to enable me to track how a kind of event, disruption, interactions, and various actors came to be implicated, triggered or were triggered using this time perspective. The case research approach also facilitated this approach. One of its benefits is that it provides a chance to remain close to the field so that a theoretical insight can be built up through a constant interplay between what was observed, and how it can be interpreted (Dubois and Araujo, 2007). It was an approach that aligned with the INA, where change was seen as something that develops through actors' interconnected actions, activities, and resources. In this view, the network was not a passive context but an active part of the phenomenon both shaping and also shaped by the changes under study (Håkansson and Snehota, 1995, Easton, 2010).

3.2. Case selection

The empirical foundation of this thesis consists of two instrumental case studies selected to provide insight into the dynamics, challenges, and processes that shape the implementation of circularity in business networks. Together, these two cases were selected, because they involved important relationships between different actors, actively engaged in circular initiatives, and offered good access to detailed data over time, including interviews, documents, and internal materials. This purposeful sampling approach (Patton, 2002) was appropriate given the complexity of the studied phenomena and the necessity of ongoing engagement with participants. By studying a contemporary and evolving case (Study I), it was possible to observe the early formation of CSC relationships and how they are initiated, where tensions arise, and how actors respond in real-time. This perspective complements the more retrospective and structured insights from Study II, in which the circular transition is more advanced and institutionalized. Together, the two cases offer a more comprehensive view: one illustrates how circularity is coordinated; the other shows how it becomes formalized, stabilized, and embedded over time.

Table 2. Background information on the focal case companies

Focal case company	**Alpha**	**TEMP**
Industry	Automotive retrofit / e-mobility	Life Sciences
Number of employees	12	14 36 short-term personal
Year of foundation	2019	1986
Core products	Conversion of diesel vehicles to electric	End-to-end temperature control
Study I/II	Study I	Study II

Table *2* provides the background information on the focal case companies. The first case, Alpha, a start-up founded in Sweden in 2019 centered on converting diesel vehicles to electric drivetrains, offering a complementary context in which circularity is mobilized through emergent, cross-actor collaboration. This single case was selected, because it presents a

compelling example (Siggelkow, 2007) of the emergent phenomenon in a real-world setting (Edmondson and McManus, 2007) in which Alpha created a new innovative response to a nascent marketplace. The case was selected because it (i) provided the opportunity to investigate the development and implementation of CSCs in a nascent market, (ii) the focal firm needed to establish new collaboration with multiple actors, (iii) the abundance of tension in the CSCs, and (iv) good access to Alpha and its four customers for data collection. This case study allows me to explore Alpha's CSC collaborations with these customers, who provide their own diesel trucks for conversion to electric vehicles, a concept new to the involved actors.

The second case, TEMP, is a long-standing SME firm that went through the process of a transition to circularity that provided the opportunity to examine in-depth multi-level interaction and change. The TEMP case represented a unique opportunity for Study II owing to the specific circumstances of the company's shift from fully linear to fully CSC. This shift gave the chance to witness in real-time (Edmondson and McManus 2007) the way in which interactions were changing between the firm itself and with buyers and suppliers, and with the larger network. So, the value of this case was the prospect of watching interaction triggered circularity and seeing those interactions evolve at different levels over time. The pandemic was the primary driver of these circumstances. Businesses engaged in temperature-control logistics and services, which supplied critical equipment for vaccine distribution were among the severely affected (Singh *et al.*, 2020). The following global chip shortage that shook many industries created ripple effects (Marinova and Bitri, 2021). TEMP was not a semiconductor manufacturing company per se but was heavily reliant on electronics and related components. TEMP was in demand during the pandemic and provided temperature-control technology that was critical to vaccine distribution (Khan and Ali, 2022). This disruption compelled the firm to reconsider its way of doing business and in doing so opened up room to shift away from traditional linear modes and towards CSC solutions. Increased pressure from the global chip shortage during the crisis forced the firm to launch a CBM that focused on recycling existing products and reducing reliance on new electronic components. This change was accompanied by a reconfiguration of interactions among various levels of the organization. Consequently, TEMP implemented a recovery and re-use of its products in industrial markets through a developed system. This case was selected to be analyzed in the current study because it presents a distinct demonstration of a firm that has moved from a linear to a complete CSC.

Five customer firms were interviewed across both studies in this thesis. Four were part of Study I, which focused on a start-up's vehicle electrification initiative within the food and beverage sector. One customer was included in Study II, offering a perspective from the pharmaceutical industry with strict cold-chain requirements. Customer A provides online food shopping and home delivery of food to consumers. It has a goal of electrifying 50% of its vehicle fleet in 2025. The fleet includes 430 small trucks and 2 upgraded vehicles. Customer B delivers food to schools, restaurants, and hotels. It was established after a fusion between two actors. It has a goal to improve the sustainability of its transport, but it does not specify how much of its investments will be in electric vehicles, instead, it aims to be open for multiple sustainable transport solutions. The fleet includes 400 heavy trucks and 1 upgraded vehicle. Customer C delivers food to stores and has a smaller business of e-commerce with home delivery of food to consumers. Customer C was formed through the fusion of three actors. The goal is to have

50% electrified transport by 2027. The fleet includes 200 heavy trucks, 60 small trucks, and 1 upgraded vehicle. Customer D delivers food and drinks to different organizations in Sweden and Germany. The goal is to be leading in sustainable and innovative food and drink solutions for work sites. The fleet consists of electric vehicles and vehicles using HVO100. The goal is to have all its 3.5-ton vehicles to be electric. The fleet includes 180 vehicles and 1 upgraded vehicle. Customer E is a global biopharmaceutical company with operations in Sweden, involved in temperature-controlled logistics for vaccine and medicine distribution, which played an important role during the COVID-19 pandemic, requiring high-performance, reliable cold-chain transport. The fleet includes specialized medical transport. Table *3* provides a summary of the background information on the customers.

Table 3. Background information on the customers

Customer	**Customer A**	**Customer B**	**Customer C**	**Customer D**	**Customer E**
Industry	Food retail	Foodservice distribution	Food retail and e-commerce	Food and beverage delivery	Pharmaceuticals
Number of employees	1800	3300	2000	300	94300
Year of Foundation	2006	2012	2000	1995	1999
Study I/II	Study I	Study I	Study I	Study I	Study II

One of the methodological challenges I had during this research was defining the boundaries of the cases and the phenomenon under study. This is a well-known difficulty in network and systems-oriented research, where interactions, roles, and resources often stretch across organizations (Halinen and Törnroos, 2005). In the context of CSCs, where change happens through evolving relationships rather than clearly defined structures, this challenge became especially apparent. Since the focus is not only on firm-level change but on how circularity emerges through networks and interactions, the boundaries of the phenomenon were not predefined but developed through empirical engagement. Both studies required tracing how actors coordinated, adapted, and responded to challenges, shifting business models, and tensions. This made the unit of analysis inherently fluid, requiring careful attention to where and how circular initiatives were taking shape (reflected more in the summary of the appended papers).

3.3. Research method and data collection

In both case studies, the primary data collection method was semi-structured interviews with key actors, complemented by extensive secondary data. Semi-structured interviews, which are more flexible (Bryman and Bell, 2015), allow new topics to arise during the conversation and enable interviewees to reflect on and discuss issues and events that they consider important. The interviews focused on several key themes, such as how circularity was understood and initiated within each organization, the triggers and motivations behind engaging in circular practices, and how actor roles, relationships, and responsibilities evolved throughout the process, interactions with partners, experienced challenges, and responses. This flexible format

allowed respondents to recount processes and critical events on their own terms while ensuring core themes were discussed. A total of ~20 interviews were conducted across the two cases (Table *4*), ranging from 30 minutes to 2 hours.

Table 4. Summary of data sources and collection methods

Study	Sources	Interviewees
Study I	12 Interviews 3 Site visits Customer internal industry report Media articles and press releases Conversion webinar	Firm - Alpha CEO Firm - Alpha COO Firm - Alpha manager for customer projects Customer - Transport manager (Customers A, B, C, D)
Study II	8 Interviews Published report Published case study 1 Site visit Previous data gathered (2 interviews, 1 site visit, roundtable discussions, 2 presentations)	Firm - Temp CEO Firm - Temp COO Firm - Temp head of supply chain & trade compliance Firm - Temp chief revenue officer Firm - Temp key account manager Customer - Global sourcing manager

Interviewees included company executives, project leaders, customers, and other actors directly involved in the circular initiatives. All interviews were recorded with permission, transcribed, and coded for analysis. In addition to interviews, we collected secondary data to triangulate and enrich the case studies. This included internal documents (e.g. strategy presentations, meeting minutes, reports on sustainability efforts of the companies), publicly available materials (press releases, news articles, website information), and other content such as published case studies or project documentation within the case companies.

Instead of collecting all the data at once, I have moved back and forth between fieldwork and analysis, following an inductive, theory-building approach (Dubois and Gadde, 2002). Throughout, I revisited interview transcripts and secondary materials to refine interpretations and, where necessary, collect additional data to strengthen and clarify the findings. For example, an interview with a customer was added when more information was needed from that perspective. The analysis started with basic coding and progressed to the identification of key themes.

3.2.1 Study I

Study I is a case study of a network-level CSC initiative led by a technology start-up focused on converting diesel vehicles to electric vehicles. This initiative represents an innovative approach to circularity for extending the life of existing vehicles (a circular strategy) through collaboration across multiple actors (the start-up, suppliers, vehicle owners, and other actors). The case was designed to illuminate the tensions and collaborative responses in a nascent circular business network. Data collection in Study I was slightly intensive, capturing the formation of the conversion project. 12 semi-structured interviews were conducted involving the start-up's team and its customers (Table *5*). Within Alpha, we interviewed the CEO/founder, COO, and the manager for the customer projects, to understand Alpha's motivations, business model, and the challenges they faced in scaling their solution.

Table 5. Data sources

Type of data	Data source	Date
Interviews	Alpha - CEO (2 interviews), 10+ years' experience in electric vehicles and logistics operations	March 6th 2023
		Jan 31st 2024
	Alpha – COO, 10+ years' experience in electric vehicles and logistics operations	March 6th 2023
	Alpha - Manager for customer projects (3 interviews), 10+ years' experience in electric vehicles and logistics operations	March 30th 2023
		June 14th 2023
		Sep 21st 2023
	Customer - Fleet Manager, Customer A (3 interviews), 2 years' experience in logistics operations	March 27th 2023
		June 21st 2023
		Sep 28th 2023
	Customer - Transport Manager, Customer B, 10+ years' experience in logistics operations	March 22nd 2023
	Customer - Transport Manager, Customer C, 15+ years' experience in logistics operations	Nov 2nd 2023
	Customer - Transport Manager, Customer D, 15+ years' experience in logistics operations	Nov 21st 2023
Observations	3 half-day visits to the Alpha's facilities in a 12-month period	2023-2024
Secondary qualitative data	Customer internal industry report	2023
		2022
		2021
	Media articles and press releases	March 2023
		July 2023
	Conversion webinars	Dec 12th 2023

To represent the broader network, we interviewed the transport managers of 4 customers of Alpha. These interviews helped the study to map out the network structure and capture multiple viewpoints on key issues. In addition, the secondary data from the meeting notes from multi-actor workshops, press articles about the initiative, and technical documentation on the conversion process as used. The data was approached with an eye for critical events or turning points where tensions surfaced or peaked, such as a breakdown in negotiations, a technical failure during a pilot test, or an external shock like a regulatory barrier. Each such event was analyzed in terms of the tension category it was part of (e.g., market development, regulations, organizational) and the collaborative response (if any) that followed. The collected data were coded following the process suggested by Gioia *et al.* (2013). The analysis sought to uncover patterns of the key collaborations and implications related to those tensions.

3.2.2 Study II

Study II is a longitudinal, process-oriented case study of an established company undergoing a strategic transition toward CE practices. The focal firm, working in the life sciences in its industry, initiated a circularity program aimed at redesigning its products and supply chain for reuse, recycling, and service-based offerings. This study was designed with a processual lens analyzing the multiple levels of interactions (firm, dyad, and network) to capture how circular transitions emerge through these interactions over time. 10 semi-structured interviews were conducted for this study (Table *6*).

Table 6. TEMP firm sources of data

	Data source	Duration /Amount	Date
1	Interview with CEO	60 minutes	May 2021
2	Roundtable discussions (on the flexibility of responses to Covid-19)	3 hours online	December 2021
3	Presentation by CEO	45 minutes in person	March 2022
4	Presentation by the head of design	30 minutes in person	Sept 2022
5	Site visit 1	40 minutes	Sept 2022
6	Interview with the head of design	60 minutes online	Oct 2022
7	Site visit 2	60 minutes	May 2023
8	Interview with CEO	65 minutes online	June 2023
9	Published report on "A sustainability analysis of the electronic components" with TEMP	1 report (61 pages)	July 2023
10	Interview with COO	50 minutes online	July 2023
11	Interview with the Head of Supply Chain & Trade Compliance	45 minutes online	August 2023
12	Interview with the Head of Supply Chain & Trade Compliance	45 minutes online	September 2023
13	Interview with the key account manager	55 minutes online	September 2023
14	Published case study of TEMP and a customer	1 report (7 pages)	September 2023
15	Interview with the chief revenue officer	45 minutes online	March 2024
16	Interview with the global sourcing manager of one of TEMP's key customers	60 minutes online	May 2024
17	Interview with the global sourcing manager of one of TEMP's key customers	50 minutes online	February 2025

Within the firm, the CEO, COO, the managers from the supply chain, and design department, and the key account manager were interviewed. These interviews provided insight into internal processes, e.g. how the firm developed a CBM, reorganized, and tackled operational changes (like new reverse logistics or product-as-a-service models). Secondary data such as TEMP's annual reports and internal documents were also used to contextualize the firm's journey. The analytical focus of Study II was to trace the process of TEMP's transition toward circularity and identify factors that enabled or impeded progress at different levels. Following recommendations for process research in business networks, special attention was paid to temporality and connected events across levels. Data analysis was conducted using an inductive coding approach, whereby collected data, were systematically analyzed to identify key themes, patterns, and categories. Following the suggestions in process research work (Langley *et al.*, 2013) we combined different strategies for analyzing process data. A visual mapping strategy was used to illustrate precedence, progression, and parallel processes. Codes were iteratively refined and organized into a coding framework to facilitate data interpretation.

3.4. Research process

The research process for this thesis was iterative as I moved between empirical material and theoretical understandings, in line with the logic of systematic combining (Dubois and Gadde, 2002). Figure *3* presents a timeline of key milestones from the start of the PhD in March 2023

through to the licentiate seminar planned for May 2025. It shows when empirical data collection began, the research proposal was completed, and the two associated papers were submitted for academic review. The first study led to a paper submitted in December 2024, which received a major revision in February 2025 and was resubmitted in April 2025. The second study resulted in a paper submitted in February 2025 and the manuscript is currently under review.

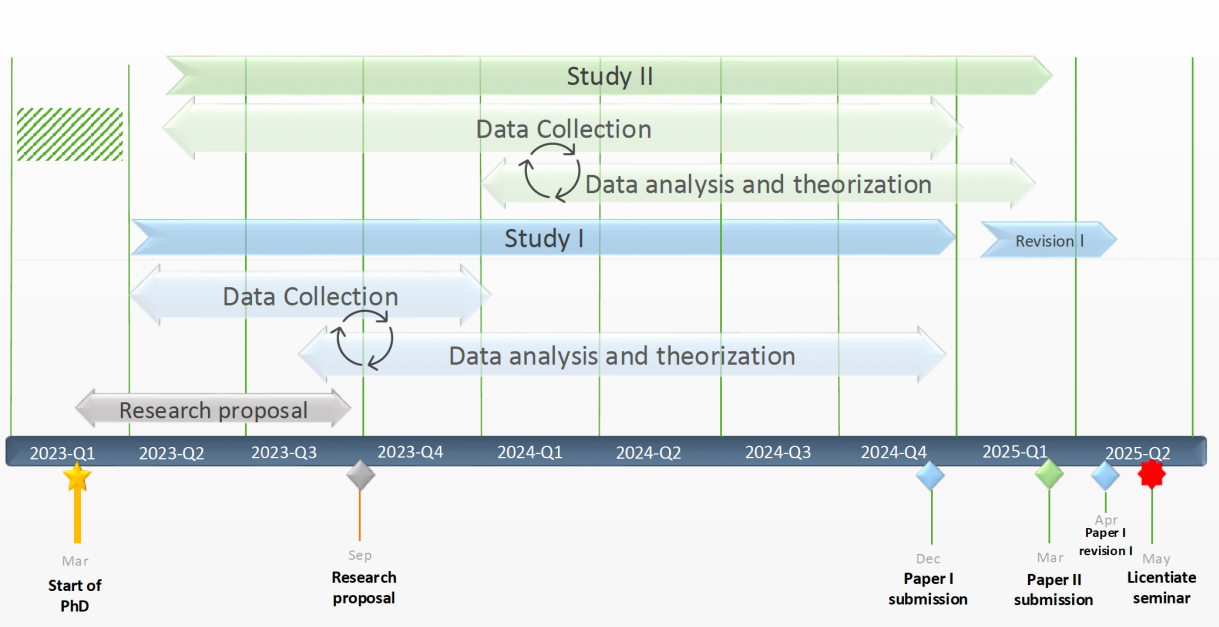

Figure 3. Research timeline and milestones

Data collection started soon after I began my PhD work, facilitated by my supervisors' early access to the empirical sources. I commenced the PhD project in March 2023, initiating interviews and site visits for data gathering relevant to Study I. The empirical foundation for Study II was already partially in place. The TEMP case in Study II was initially developed as an on-going research project in 2021, during which my supervisors were already engaged in data collection. I was granted access to this dataset, which included interview transcripts, internal documentation, and field notes, and I extended it through additional interviews, a site visit, and document analysis. This continuity enabled a longitudinal perspective, allowing me to follow TEMP's transition toward circularity across time and organizational levels. In parallel, I initiated data collection for Study I, which centers on a technology start-up aiming to convert diesel vehicles to electric through collaborations with public and private firms. Both studies were shaped and refined through participation in internal research seminars, doctoral workshops, and academic conferences such as IMP, IPSERA, EurOMA and NOFOMA. These forums offered valuable feedback that helped adjust the analytical focus and theoretical contribution of each paper.

The research started with a general interest in how circular practice is put into action but gradually shifted to a more specific focus on the actualities of circularity and how it is co-created, challenged and reconfigured by interacting actors. The INA's model of ARA

(Håkansson and Snehota, 1995) remained a key framework to utilize, especially in relation to the mapping of relationships among actors, resources, and activities. In order to gain a more complete picture of network points of conflict and alignment, additional concepts such as tensions were added to the model with the ongoing development of the cases. And upon getting more data in, the research questions were gradually modified. From being focused on firm-level change to being about seeing how circularity is developed over networks and over time, the shift is illustrative of the way in which the research remained close to empirical material. Ultimately, circularity is no longer handled in this thesis as a static aim, but rather as something which is in constant shaping and reshaping through interaction among actors within the network.

As the research progressed, both the direction and focus of the thesis evolved in reaction to what I was finding in the field. Initially my research questions had been about how firms shift to CBMs, what networks of partners and suppliers facilitate that transition, and how relationships in circular initiatives, particularly in start-ups and smaller firms, develop over time. These research questions informed my initial interviews and theoretical framing. However, with more material and case analyses in hand, it became apparent that circularity is not something that is simply something that firms choose to implement. Rather, it is something that emerges and is developed through ongoing interaction, collaboration and often tensions between various actors in a network. The time dimension of circularity also emerged more and more importantly in my research. Circular initiatives evolved over time, changed direction, and reacted to a combination of internal and external triggers. This called for tracking what had evolved over time, how roles were redefined and in which way circularity was embedded in various points in time.

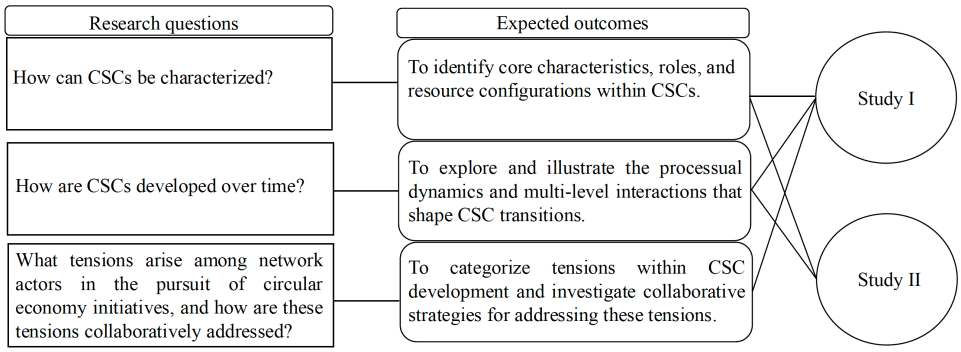

Figure 4. Research questions and expected outcome in relation to empirical studies

The two studies developed alongside each other, and insights from one helped shape the focus and interpretation in the other. This ongoing dialogue made the overall research more focused and connected. What I observed in one case helped me ask better questions and notice different things in the other. For example, in study I, I saw how uncertain roles and technical adjustments required actors to constantly align their expectations and resources. This led me to pay closer attention in study II, to how a more structured organization deals with similar coordination challenges but in a more formal and planned way. Figure *4* shows the research questions and their expected outcomes in the thesis, showing their connections to Study I and Study II.

3.5. Research validity and reliability

In the assessment of qualitative research, the concept of trustworthiness of the research is taken into consideration (Guba, 1981, Lincoln, 1985). Trustworthiness consists of four different dimensions: credibility, transferability, dependability, and confirmability.

Credibility refers to confidence in the truth of the findings. This study enhanced credibility through data triangulation and reflexivity. Multiple data sources, such as interviews, observations, and documents, were used and combined to validate key patterns (Patton, 2002, Yin, 2018). The two case studies provided a form of theoretical replication, demonstrating findings were consistent across distinct contexts, but also within the individual studies (Eisenhardt and Graebner, 2007). Transparency in reporting how data were collected and interpreted helped to ensure that the conclusions closely reflect participants' perspectives rather than researcher bias (Bryman and Bell, 2015).

Transferability involves the extent to which findings apply in other contexts. To support transferability, the study provides rich contextual detail and links results to the existing theory. Emergent themes are connected to prior research (Eisenhardt and Graebner, 2007), and the boundaries of each case context are described. The single-case design allowed for in-depth insight into a specific CSC context, and while the findings are not statistically generalizable, the detailed description enhances analytic transferability and helps readers recognize parallels in similar industries or organizational settings (Yin, 2018, Eisenhardt and Graebner, 2007).

Dependability addresses the consistency and stability of the research process. Systematic analysis procedures were used to ensure dependability. To enhance reliability, the study maintained documentation of data and procedures, compiling a database, including interview transcripts, field notes, and document archives (Yin, 2018). Furthermore, the reliability of this thesis has been enhanced by being offered recommendations and constructive criticism throughout the progress of this thesis in various conferences and peer review sessions.

Confirmability addresses the objectivity of the findings and their grounding in the data. For enhancing confirmability, the coding procedure preserved first-order concepts from the participants' own language (Gioia *et al.*, 2013), ensuring interpretations stayed close to the data. Second, team feedback sessions and collaborative coding were used as checks, allowing other researchers to refine the analysis. Also, the transparent documentation and the existing database provide a chain of evidence to ensure that conclusions are traceable and not merely reflections of the researcher's presumptions.

Regarding the ethical considerations of the research and data collection, participation was voluntary, and interviewees were informed of the purpose of the study before giving permission. Confidentiality was ensured through pseudonyms and withholding of identification details. Such ethical conduct maintains participants' rights enhances the methodological quality discussed above, and enhances the trustworthiness of the study (Allmark *et al.*, 2009).

Throughout the research, it is important to reflect on the fact that the case companies were merely observed from the outside. The involvement of the author in directing how the cases were approached, interpreted, and presented should be taken into consideration. In both studies,

deliberate choices were made about where to direct attention, which actors to collect data from, and how to frame the transition that was witnessed. Throughout the whole research, the objectivity of the research questions, methodological choices, and empirical findings has been upheld through open discussion with supervisors, conference presentations, and peer seminars serving as checkpoints. It is important to recognize these issues and reflect on them.

4. Summary of the appended papers

This chapter presents the key empirical findings from two appended papers. Each paper investigates CSCs in a different context: Paper I focuses on a start-up forming a new CSC by converting diesel trucks to electric vehicles, and Paper II examines an established SME transitioning from a linear to a fully CSC. The findings from these studies collectively address the thesis research questions on (1) how CSCs can be characterized, (2) how CSCs evolve over time, and (3) what tensions arise among network actors in CSCs and how these tensions are collaboratively addressed. Table *7* presents a summary of the two papers included in the thesis.

Table 7. Overview of the appended papers and their relation to the research questions

	Paper I	**Paper II**
Title	*Overcoming tensions in CSCs through collaborative networks*	*Interactions in business networks on the journey towards circularity*
Status	Submitted to an academic journal - December 2024 Resubmitted after major revision and under peer review - April 2025	Submitted to an academic journal and under peer review - February 2025
Empirical Focus	Vehicle conversion in a CSC (start-up context)	CSC transition in B2B industrial setting (SME)
Purpose	To identify tensions in CSCs and examine how actors collaborate to address them	To explore how multi-level interactions contribute to the development and stabilization of CSCs
Phase of Circularity	Formation and implementation of CSC	Transition from linear to CSC
Research Design	A qualitative single-case study using the Gioia method	Longitudinal case study using a process research approach
Main Findings	Identifies five types of tensions and shows how they are managed through operational, strategic, and relational collaboration	Develops a temporal and multi-level interaction model to explain how CSCs evolve through ongoing interaction
Contribution	Provides a typology of CSC tensions and links them to specific collaboration strategies	Offers a processual framework for understanding CSC development through firm, dyadic, and network-level interaction
Unit of analysis	Collaboration between ALPHA and its customers	Interaction of TEMP in its business network
Related RQs	RQ1, RQ3	RQ1, RQ2

Paper I contributes primarily to RQ1 and RQ3, while it does not explicitly address RQ2, as the time dimension was not central to the analysis. However, the study that was conducted for it, and the early stages of analysis of the data, offered insights into the early growth stage of a CSC and how collaboration had to evolve when the start-up was scaling up its operations. These insights complement the longitudinal perspective of Paper II by showing the beginning

stages of CSC formation to support a broader understanding of CSC development, as Paper II takes a more explicit process perspective.

4.1. Paper I

Context

Paper I studies the case of Alpha, a technology start-up that leads a CSC in the automotive sector. Alpha's business involves converting diesel trucks into electric vehicles, effectively giving heavy-duty vehicles a second life and reducing waste. This innovative CBM requires building a new supply chain network from scratch, involving vehicle owners (customers who provide used trucks for conversion), component suppliers (for batteries, electric drivetrains, etc.), service providers, and regulatory bodies (for vehicle approval and compliance) (Figure *5*). Because Alpha operates in a nascent market (electric conversion of existing trucks is an emerging practice), the study paid special attention to the collaboration among actors and the tensions that arose as the network took shape.

Core Findings

The Alpha case reveals that forming a CSC in a new industry context comes with inter-organizational tensions, but that these tensions can act as both challenges and opportunities. The analysis identified five main categories of tensions in Alpha's network: (i) Market development tensions; for example, customers were cautious about the unproven conversion concept, facing high upfront costs and uncertain resale value of converted trucks; (ii) Organizational tensions; Alpha needed to design flexible conversion processes within traditionally rigid automotive systems (e.g. integrating new electric components had to fit into existing vehicle structures and standards); (iii) Network relationship tensions; the close, trust-based collaboration that Alpha had with early partners became strained as the company began scaling up, leading to potential misalignments in expectations and communication; (iv) Technological tensions; unforeseen technical hurdles emerged (such as issues in components or software integration) that no single actor could solve alone; and (v) Regulatory tensions; ambiguous or restrictive regulations for vehicle modifications created uncertainties and delays (for instance, weight classifications and safety certifications for converted trucks did not readily fit existing rules).

Rather than seeing these tensions as purely negative, the study found that they served as "pressure points" prompting innovation and cooperation. In many instances, a tension highlighted where the network needed to adapt. For example, technological problems during conversion (complex integration of batteries and control systems) underscored the need for closer technical collaboration with suppliers and iterative problem-solving among engineers across firm boundaries. Similarly, regulatory hurdles forced Alpha to engage proactively with authorities, turning compliance challenges into a collaborative effort to shape guidelines that would accommodate the new technology. Also, collaboration was identified as the key mechanism through which Alpha and its partners navigated these tensions. Actors in the CSC

leveraged their relationships in targeted ways to address specific types of tension. In practice, this meant employing different forms of collaboration for different problem domains.

First, operational and supply chain collaborations were the 'key' collaborations used to tackle organizational, networked relationships, and technological tensions. For example, Alpha collaborated with component manufacturers and external workshops to design technical solutions together and perform tests and adapt the conversion process according to problems that emerged. Such hands-on collaborations spread the innovation burden among the network and resolved technological uncertainties and synchronization of the conversion process with the capabilities of partners.

Second, strategic and economic collaborations were discovered as the 'key' collaborations employed to address all five tensions referred to above. For example, Alpha launched pilot projects and joint investments with its large transport clients to share the cost risk of pilot-testing the converted vehicles and entered into negotiations with regulators to acquire exemptions or shape the more flexible regulatory frameworks.

Third, relational and value-based collaborations were significant in coping with tensions in market development and network relationship management. Alpha's initial operations were supported by intense personal relationships on site and in regular informal communication and a shared vision of sustainability with initial customers and suppliers. Such value-based relationships helped harmonize diverging aims and mitigate the challenges of scaling up.

The study points out that neither of the actors was capable of transcending the tensions in a solo effort and that it was the interaction of such collaboration that enabled the establishment and functioning of the CSC. Tensions served to be the driver of increased collaboration, innovation and to propel the network towards establishing competence-building that did not exist before. The Alpha case illustrates a CSC to be a network extending beyond traditional supply chain functions with nearby customer involvement in innovation, collaboration with suppliers in design and production, and even horizontal collaboration with regulators and government authorities. It also captures the initial development phase of a CSC, observing how the collaboration routines had to adjust as the start-up increased in size. These findings complement Paper II's longitudinal perspective in revealing the initial phase of CSC development.

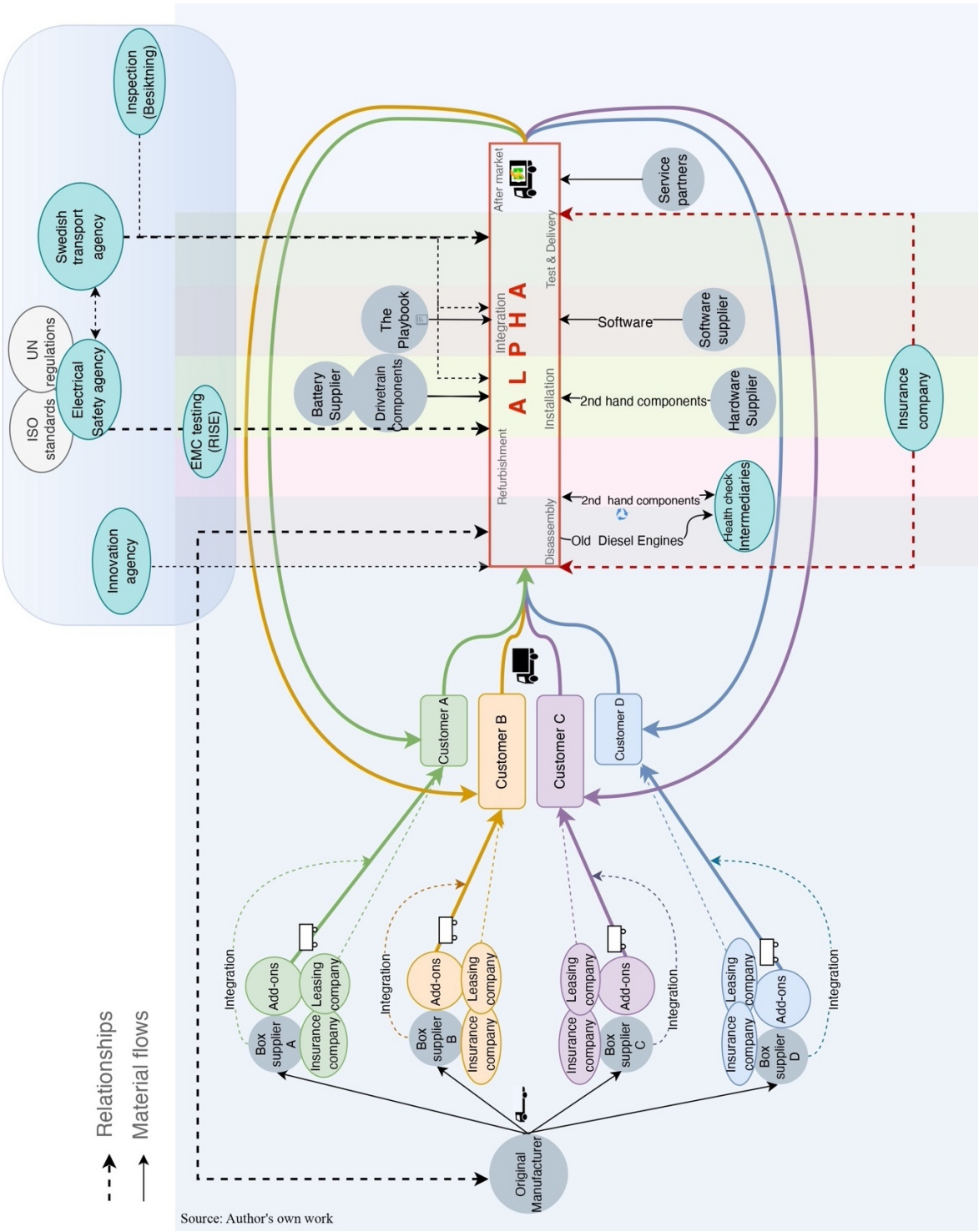

Figure 5. Map of actors, relationships, and material flows of Alpha's CSC

4.2. Paper II

Context

Paper II studies the case of TEMP, an established SME that shifted from a 100% linear supply chain to a 100% CSC (Figure *6*). TEMP produces durable equipment (e.g. data logger devices used in cold supply chain management) and historically operated on a linear make-use-dispose basis. In response to strategic sustainability aims and resource constraints, the company initiated a transition to circular practices, to reuse and refurbishment of its products. The study traced TEMP's multi-actor interactions over some time (2021-2025) to understand how circularity was implemented in practice. Three levels of interaction were analyzed: within the firm (internal operations and organization), in dyadic relationships (especially between TEMP and its customers), and across the broader network (including suppliers, logistics partners, and industry context), from its own (TEMP) perspective.

Core Findings

The conversion to a CSC at TEMP was an evolving process rather than an instantaneous change. The firm's conversion was triggered by both internal strategy and external pressures. At the firm level, top management recognized the waste and inefficiency of the single-use loggers, and this triggered internal adjustments. TEMP created new processes of reverse logistics and product lifecycle management, such as a control system to monitor and recover used devices and an investment in refurbishment capability. Such internal adjustments made circular practices a part of standard operations and were accompanied by educating personnel and adjusting roles to manage returns and reuse.

At the dyadic level, interactions with the customers moved from initial enforcement to collaboration. In the early stages, many customers were resistant to returns of used devices, and this created tension between TEMP's circular ambitions and the customers' established practices. TEMP addressed this both by more follow-up communications and revising customer contracts to incentivize the returns (such as environmental fees in case of non-return), and this lifted return rates. Through ongoing engagement, providing guidance, aligning on sustainability targets, and having a flexible third-party logistics provider in order to facilitate returns, TEMP and its customers moved towards a more collaborative relationship with a view in supporting circularity.

At the network level, broader supply chain disruptions and industry events played an important role. For instance, a worldwide shortage of semiconductors produced a shortage of new components, and this unexpectedly resulted in the wider acceptance of refurbished devices by customers. Similarly, worldwide environmental commitments and regulations (in the pharmaceutical sector) placed pressure upon all actors to prioritize the ongoing service to the customers and adapt to the existing solution as in circular strategies. TEMP leveraged its network to overcome challenges. It negotiated closely with component suppliers (and second-tier suppliers) to secure necessary parts for refurbishment and piloted with a selected few to test and firm up the circular returns system before expanding. Such network interactions not

only helped overcome immediate crises (such as shortages of parts) but also created trust and knowledge for long-term circular operations in the future.

The TEMP case indicates that CSCs evolve through distinct phases. In the emerging phase of the transition, interactions were frequent, adaptive, and focused on experimentation. For instance, trial-and-error learning is used to improve return logistics and negotiating new agreements with customers. This phase was marked by uncertainties and even tensions (such as misaligned expectations and initial pushback from customers), which had to be managed in real-time. As the firm moved into a more established phase, the interactions became more routine and systematized. Circular processes were standardized and embedded into business-as-usual operations.

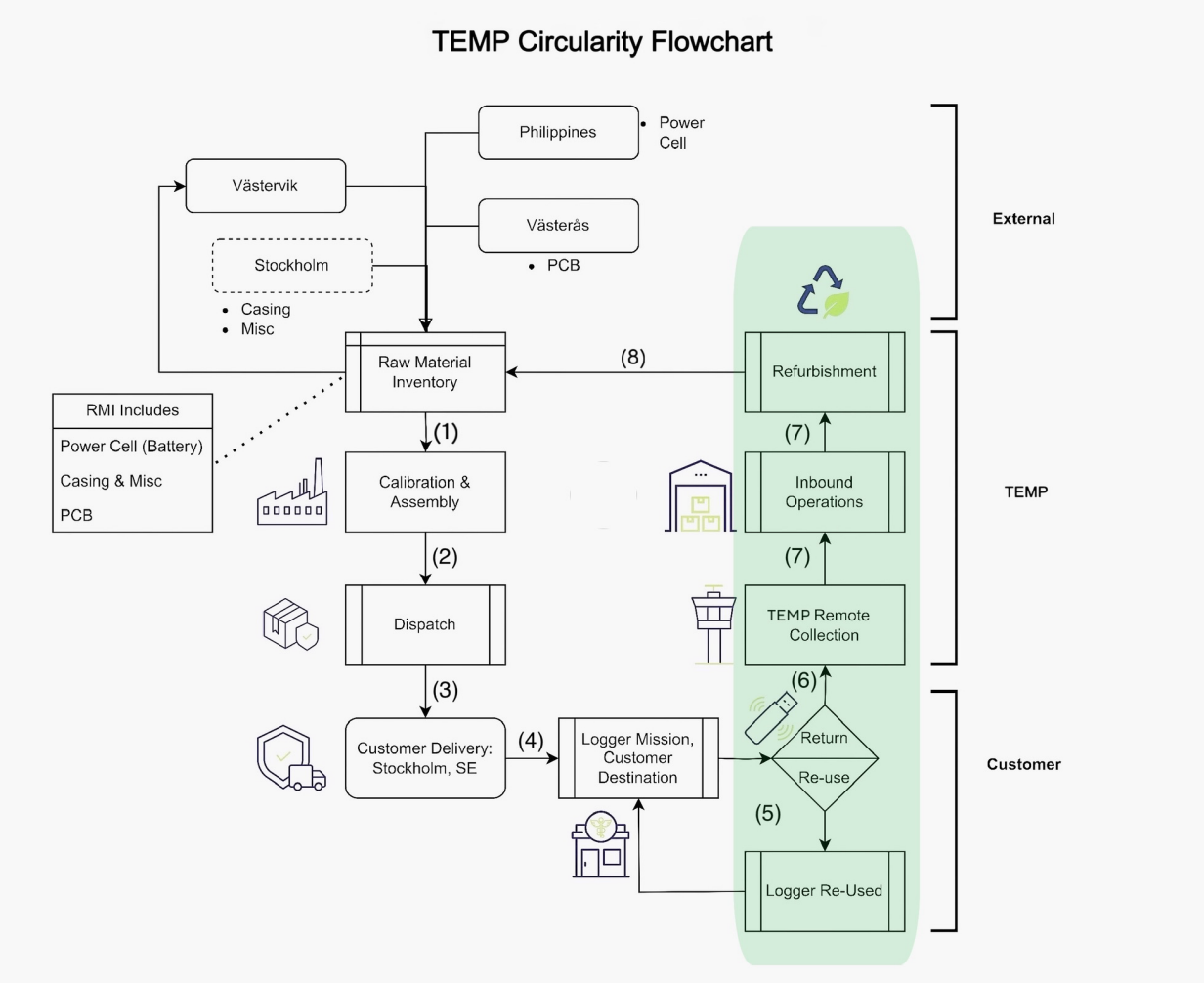

Figure 6. An illustration of TEMP's CSC

It is important to state that, evolution was not strictly linear. In the initial stages of collaboration or transition, the way actors interacted and what they learned from those experiences often led them to adjust or change their strategies, behaviors, or processes. The observations show that CSC evolves in an ongoing cycle where triggers lead to new interactions, which in turn firms gain experience, identify challenges, and learn what works, so further learning and adaptation

are generated. Finally, while Paper I did not center on tensions in the terminology of RQ3, it nevertheless documented several tensions and how they were resolved collaboratively. A clear example is the tension between TEMP and its customers around product returns that was addressed with frequent communication follow-ups and incentivized contracts. Similarly, tensions arising from supply uncertainty, due to the chip shortage, were addressed by network collaboration, with TEMP coordinating across its supply chain to ensure access to parts. So, the findings also confirm that implementing a CSC involves multi-level collaboration, such as internal coordination, close customer-supplier partnerships, and engagement with external network actors are all necessary to make circularity work.

5. Discussion

This chapter discusses the key findings of the two studies in this thesis, in relation to the three research questions.

5.1. Research question 1

RQ1: How can CSCs be characterized?

Multi-Actor and networked structures

The findings from this research show that CSCs are characterized by multi-actor, networked structures that extend beyond traditional dyadic buyer-supplier relationships. In contrast to linear supply chains, which often involve a focal firm coordinating a relatively predictable flow of materials, CSCs involve a broader network of participants working together to recirculate resources. This looping of resources means that firms in a CSC are not only producers or consumers in a chain, but also often become suppliers of used products or recipients of returned materials, blurring traditional supply chain roles. The actor, resource, and activity configuration of a CSC is therefore distinct. Actors include not only buyers and suppliers but also end-users, service providers, intermediaries, and even regulatory or research bodies; resources include end-of-life products and technical knowledge for recovery processes; and activities span traditional production as well as reverse logistics, refurbishing, and other restorative processes (Batista *et al.*, 2018, De Angelis *et al.*, 2018).

These characteristics demand collaboration across the entire network rather than isolated firm efforts (Marques and Manzanares, 2022). Indeed, circularity cannot be achieved in isolation. It emerges through interactions across a network of organizations with varying roles and interests (Håkansson and Snehota, 1995, Leising *et al.*, 2018). The need for coordination is greater than in linear supply chains because each actor's actions (e.g. returning a used component or investing in refurbishment capability) directly affect others. Even a single company's change toward circular practices can ripple through and necessitate adjustments by others in the supply chain (Yang *et al.*, 2018). This study demonstrated this interdependence as when the focal firms pursued circular innovations, their partners had to adapt processes and expectations (for example, customers had to adapt logistics to send back used items, and suppliers had to handle more complex order and return patterns). Information sharing and joint problem-solving became routine, reflecting that frequent interaction and trust are foundational elements of CSCs (Weetman, 2016, Arvidsson and Melander, 2020). This stands in contrast to arms-length transactions in linear chains. In CSCs, firms are more tightly coupled through ongoing exchanges of not only products but also data and knowledge on product life cycles.

New and diverse actor configurations, collaboration, and co-value creation

One of the characteristic features of CSCs highlighted in this study is diversity in terms of actors and roles they take. The cases that were studied pointed out that CSC initiatives tend to involve actors with different industry and sector backgrounds, forming unconventional alliances. For example, in the context of an emerging circular venture converting industrial

products for extended use, important actors included not only the focal manufacturing partners and their suppliers, but also external service workshops, innovation agencies, and government regulators. This aligns with prior observations that CSCs support connections among diverse actors, from micro-enterprises and start-ups to mega-corporations (De Angelis *et al.*, 2018). This study confirms that a circular supply solution requires input and coordination from a wider network than a linear model. In particular, horizontal connections with government bodies, industry associations, or even competitors become as important as vertical supply chain ties. These actors can grant legitimacy, knowledge, or regulatory support that makes circular practices possible (Aarikka-Stenroos *et al.*, 2022, Melander and Lind, 2022). This study confirms previous studies, showing the need for new relationships to enable CSCs (Amir *et al.*, 2023), not only with business partners but also with multiple regulatory bodies. Instead of playing an outside role as rule-setters, regulators became partners by modifying tests and compliance protocols in collaboration with the focal firm, effectively influencing the facilitation of the circular initiatives. This is an illustration of how even institutional actors can take on new roles in a CSC network (Batista *et al.*, 2019).

Embeddedness, complexity, and learning in nascent CSCs

Additionally, the complexity and nascent nature of many CSC initiatives emerged as a key characteristic. Especially in new or transforming markets, there is often a lack of established standards, leading to uncertainties in how to operate a circular model. One of the case studies took place in a nascent market for sustainable innovation, where very few established processes existed for circular operations. This situation is typical of many CSC endeavors; because CE strategies are relatively new in various industries, companies face higher uncertainty and fewer templates for action (Eisenhardt and Martin, 2000). This study showed that this nascent context required extensive experimentation and flexibility. For example, the start-up firm had to co-develop the market with its early customers, educating them, aligning on what constitutes value in a circular offering, and jointly discovering how to make the solution work. Thus, CSCs are characterized as learning networks that evolve through trial and error (Bocken *et al.*, 2018). Rather than having a clearly defined supply chain structure from the outset, the structure of a CSC often emerges gradually, through negotiation, adaptation, and sometimes "misalignment and re-alignment" among actors (Håkansson and Snehota, 1995, Chizaryfard *et al.*, 2022).

Indeed, misalignments (e.g. differing expectations or capabilities among partners) are common in the early stages and are themselves an inherent feature of CSCs that distinguishes them from more stable linear chains. In sum, a CSC can be characterized as a dynamic system that links multiple actors in collaborative processes of value recirculation. Its key elements include a broadened actor set with new roles, a strong reliance on collaboration (combining formal agreements with trust and shared vision), and an inherent complexity born of novelty, requiring adaptive and system-wide thinking. These characteristics set the stage for understanding how CSCs unfold over time and how actors manage the inevitable frictions in pursuing CE initiatives. This research supports previous studies, demonstrating that multi-actor collaborations are needed to enable CSCs (Salmi and Kaipia 2022; Ratsimandresy and Miemczyk 2024) and are important when developing innovative sustainable technological solutions to be introduced to the market possible (Melander and Lind, 2022).

5.2. Research question 2

RQ2: How are the CSCs developed over time?

The role of continuous interaction across firm, dyad, and network levels

The two studies included in this thesis approached the temporal evolution of CSCs in complementary ways. In study I, the early phases of CSC where a new firm had already initiated a CBM from the beginning and was progressing towards scaling up the operations were studied. In study II, the transition from linear to the formation of a CSC in real-time, following an SME firm was observed. This provided a processual perspective to see the change as an ongoing process of interaction (Langley *et al.*, 2013, Grimm *et al.*, 2024). In line with the INA, change in business networks unfolds through the interconnected actions of actors, activities, and resources (Håkansson and Snehota, 1995). Circularity is often introduced with an emerging phase and moves towards an established phase as shown in Table *8* (adapted from paper II for the TEMP case). This study examines the continuous interactions across three critical levels of firm, dyadic, and network, each contributing interdependently to the overall transition (Aarikka-Stenroos *et al.*, 2018, Ford *et al.*, 2011). This is due to the fact that CSCs are not shaped by changes within a single firm alone and they emerge from the interplay between internal restructuring, adaptations in individual relationships with other actors, and broader shifts in the surrounding network (Ranta *et al.*, 2020).

Early-stage development in the emerging phase

Network interactions evolve over time, from initial trigger-driven collaborations to structured partnerships and process standardization. To enable the transition, the firm needs to ensure continuous interaction processes (Håkansson and Snehota, 1995). In the study I, the transition to circularity is analyzed through three phases of the case company's operations: the initial acquisition phase (when vehicles are acquired for conversion), the conversion phase (when the technical work of converting vehicles from diesel to electric is carried out), and the post-conversion phase (when the converted vehicles are delivered and integrated into customer operations). However, even though these phases show different stages of activity, they all take place within what can be described as the emerging phase of the CSC which is studied further in study II. This means that throughout the study, CSC practices are still new, experimental, and evolving (Braz and de Mello, 2023). The firm, its partners, and its customers are testing the feasibility of the circular solution, addressing early challenges, and fixing, rather than operating within a fully established, routine, or mature circular system (Farooque *et al.*, 2019a). The focus remains on understanding how circularity is initially implemented and how actors deal with early uncertainties and tensions. They face problems and respond case-by-case, trying to fix them as they arise. In the development of the CSC was evident how the company's relationships with key customers and suppliers deepened and shifted over time. Early on, interactions were exploratory. The firm and its partners were figuring out basic questions of feasibility (e.g., can used products be converted or reused effectively?) and compatibility (how will partners' operations fit this new model?). As trust grew through repeated interaction (Ford *et al.*, 2011), those relationships became more formalized. For instance, initial informal

collaborations gave way to longer-term contracts and discussions about scaling up conversions across larger parts of the customer fleets or partnership agreements on service and maintenance support as confidence in the concept increased. Trial and error in the emerging phase builds a foundation for more structured arrangements later (Bocken *et al.*, 2014).

Progression from the emerging to the established phase

The transition from an emerging to an established CSC is not strictly linear or uniform. The development of the CSC can be recursive and uneven. Rather than a clean break between phases, there were periods where established routines had to be revisited due to new disruptions or learning. As in study II, even after reaching a mature stage, the discovery of new challenges re-triggers interactions and adaptations reflecting the early phase. This observation resonates with the idea that instead of moving linearly from one phase to the next, the transition to circularity has a dynamic flow between established and emerging phases, where elements of the new model continuously evolve (Bocken *et al.*, 2018). As the CSC initiative progressed toward the established phase, interactions became less frequent and intensive, and routines and processes took over the coordination effort (Huemer and Flygansvær, 2025). This does not mean interactions cease to matter. Interactions between firms continue to be important, but the focus of them changes. They become more strategic and long-term oriented, focusing on sustaining the partnership, rather than whether the relationship can function or the viability of it. At this stage, firms often formalize the network structure and the circular practices of refurbishing and reusing products turning into a regular service offering with its own dedicated team and performance metrics, indicating that circularity has been embedded into the company's business model and organizational structure. This aligns with the idea that within the established phase, circularity is more institutionalized over time so as to form part of "business as usual" (Geels, 2002) within the network.

Triggers accelerating circular transitions

The trigger events themselves are an aspect of temporality. External shocks or pressures, such as a supply chain crisis or new sustainability regulations, often trigger increased interactions in the network that accelerate the shift to circularity (Tollin and Vej, 2012, Tandon *et al.*, 2024). As seen in study II, an industry-wide material shortage served as a catalyst and prompted the firm and its partners to explore options to ensure supply, and as a result, effectively stimulating their circular initiative, and such triggers can sequence across levels (Melander and Lind, 2022). A regulatory change at the network level, for instance, forces intra-firm process changes and new dyadic agreements. The results show that triggers are not only one-time events, but they become part of interactions. Once the network responds to a trigger, that response becomes part of how firms collaboratively shape new ways of interacting, exchanging, and supporting new initiatives in the future. Change in CSCs is cumulative, as each iteration of interaction builds on previous ones and history matters (Håkansson and Snehota, 1995). The network's past experience with collaboration and adaptation sets the stage for how effectively it can handle the next change. It also underscores a theoretical point; business networks are active participants in change, where the pattern of interactions over time shapes the eventual structure and success of a CSC (Ford *et al.*, 2011, Schurr *et al.*, 2008).

Table 8. Interactions supporting circularity at firm, dyad, and network levels

	Interactions	
	Emerging phase	Established phase
Firm	Investing in circular capabilities by engaging in research and investment in reuse, refurbishment, and product lifecycle assessment, and integrating circularity into the firm's organizational values, moving from abstract goals to concrete actions and policies Developing strategies to anticipate and track logger returns, addressing challenges such as missing devices and communication gaps while refining expected return rates to optimize reverse logistics Implementing a centralized control tower system, actively monitoring the location of loggers, coordinating their reuse based on historical data, and forecasting and maintaining a controlled fleet of reusable devices rather than solely selling new units	Standardizing reverse logistics system, where product return is now a standard part of operations rather than an exception, structured penalties, and incentives to ensure logger returns Redefining roles and responsibilities across departments to manage reverse logistics, optimize forecasting for logger returns, oversee refurbishment processes, and ensure data security within the CSC and higher-level monitoring of the inventories
Dyad	Actively working with customers to ensure consistent product returns by monitoring return rates, adjusting incentive structures, and discussing updated contracts Collaborating with an additional third-party technology provider to enhance its product offering, integrating external innovations into its CSC model Establishing clear guidelines for device returns to prevent misallocation and assisting with sustainability reporting to meet industry requirements for customers	Establishing stricter alignment with customers by integrating return requirements into contracts, enforcing penalties for non-compliance, and creating more data, control, and visibility of each shipment to utilize them more and to support commitments Engaging in ongoing dialogue with logistics providers and customers to refine reverse logistics processes to streamline the return of loggers, ensuring efficient and cost-effective transportation while reducing environmental impact
Network	Engaging with both direct suppliers and their suppliers' suppliers, leveraging their customer relationships and industry influence to ensure prioritization during a critical supply chain crisis Initiating small-scale circular pilots with certain customers, testing product return systems and reuse strategies in collaboration with logistics and regulatory partners, and building trust among actors before broader implementation	Collaborating with customers and logistics partners to refine return processes by optimizing best pickup locations, volume, and timing for refurbishment and standardizing circular practices, making return flows predictable and efficient Integrating an additional software provider created new layers of dependency and slowed down the firm’s and customers’ ability to troubleshoot issues directly Evaluating co-alternative circularity models continuously, considering whether its current technology and partnerships remain fit for purpose, assessing whether new solutions are needed to ensure scalability and efficiency

5.3. Research question 3

RQ:3 What tensions arise among network actors in the CSCs, and how are these tensions collaboratively addressed?

One of the other findings of this research is that CSCs are involved with tensions among network actors. These tensions are fueled by misaligned expectations, the need for new incentive structures, and continuous negotiation over resource use, returns, and collaboration practices across actors (Laari-Salmela *et al.*, 2019, Huemer and Flygansvær, 2025). In a CSC, the interactions among different actors - such as manufacturers, suppliers, customers, intermediaries, and regulatory bodies - form a complex network of relationships that can cause multiple tensions. Since each actor influences and is influenced by others, these tensions are not isolated but linked. The five primary categories of tensions found in this thesis (market development, organizational, networked relationships, technological, and regulatory) originated from multiple interactions within this CSC network. Tensions can arise at various touchpoints. Changes or actions by an actor can influence other actors in the network in addition to direct communication and collaboration. To comprehend the nature of these tensions, it is necessary to investigate their specific nature, the implications they hold for the network, and the key collaborations that have been essential in navigating these tensions.

Market development tensions: the potential of a circular innovation versus the constraints of the existing market

This tension surfaces, for instance, when a company offers a novel circular product or service that promises sustainability benefits, but the market is not yet ready or willing to pay, resulting in customer hesitancy and uncertainty about demand. In this study, this appeared as the challenge of convincing customers to accept new solutions with higher upfront costs or unfamiliar value propositions, placed alongside the opportunity to create a new market segment around sustainability. It reflects a question of "what counts as value, and for whom?" when firms may see long-term environmental and cost savings value, while customers focus on immediate cost and performance which leads to a gap that the network must bridge through education or incentive structures.

Organizational tensions: flexibility and innovation versus the realities of existing structures and processes

Firms implementing circular practices tend to have to be flexible and responsive, testing new processes internally, yet they work within organizational constraints such as fixed routines, hierarchical decision-making, or limited resources. For instance, a firm may have to deviate from its standard business processes to manage returned products, new technical partnerships, and unexpected problems which can stress internal systems set up for linear flows. This tension was evident as firms struggled between entrepreneurial flexibility (adapting roles, trying new workflows) and structural inertia (Franzò and Urbinati, 2023) with legacy IT systems, and organizational silos not aligned with circular activities.

Network relationship tensions: forming deep strategic partnerships versus maintaining autonomy and control

Circular initiatives require closer collaboration and sometimes co-dependence among firms (e.g., sharing sensitive data on product use or coordinating investments in recycling facilities), which can conflict with each actor's desire to remain independent and safeguard its own interests. This study highlighted this push and pull between trust and hesitation, because they knew they required each other to be successful at circularity, but were cautious not to over-engage or be exploited. This mirrors the tension between cooperation and competition or between coordination and appropriation concerns (Brattström and Richtnér, 2014, Gnyawali *et al.*, 2016).

Technological tensions: an innovation looking conceptually simple or attractive in theory, versus the complexity to execute in practice

In CSCs, firms are typically confronted with new technologies or methods. The tension involved is between technology's promise and the practical challenge of implementing it (integration difficulties, dependability, unanticipated technical challenges). This research encountered cases where early-stage technical approaches did not turn out to function as seamlessly as intended, posing challenges and necessitating iterative development. This type of tension highlights the gap that can occur between the visionary goals for circularity and today's state of technological capability.

Regulatory tensions: support of regulations and policies towards CE goals versus existing regulations hindering implementation

Many rules and standards were written with linear models in mind and have not caught up to circular innovations, resulting in misfits. In the findings, the focal actors faced regulatory hurdles such as approval processes not designed for legal uncertainties about ownership of products or long approval times for remanufactured products. This is a classic tension of policy intention vs. operational reality. While government agendas might push for circularity, the actual compliance requirements can slow down or complicate a firm's circular project until policies adapt.

The interconnected nature of tensions and the role of collaboration in CSCs

These tensions interact and are not isolated from each other. A clear insight from this study is that an attempt to address one tension can exacerbate another. For example, solving a technological problem may require partnering with a new tech provider, which could amplify the network relationship tension (introducing new dependency), or pushing hard to develop the market (market tension) by involving customers as partners could strain the organization's resources and flexibility (organizational tension). This interwoven nature of tensions confirms that CSCs present a systemic challenge, where actors must balance multiple conflicting demands simultaneously (Pressey and Vanharanta, 2016, Chizaryfard *et al.*, 2022). The presence of such tensions is not necessarily negative, consistent with paradox theory, tensions, if well managed, become the catalyst for creativity, innovation, and improvement (Bradford *et*

al., 2004). Collaboration is studied as a key mechanism for addressing tensions in CSCs because tensions cannot be resolved by firms acting alone (Aarikka-Stenroos *et al.*, 2022). Instead, firms must engage in continuous collaboration with other actors to jointly develop solutions, align incentives, share risks, and adapt practices across firm, dyadic, and network levels to support the circular transition (Laari-Salmela *et al.*, 2019, Huemer and Flygansvær, 2025). To answer the question of how these tensions are addressed collaboratively within the network, this study contributes an understanding of the mechanisms of collaboration that allow network actors to overcome, or even harness, the tensions in CSCs. These forms of collaboration are complementary and often used in combination. This research shows that the notion that tensions in CSCs are pressure points that encourage adaptation and entail potential opportunity.

Operational & supply chain collaboration

This type is day-to-day working relationships between supply chains in order to manage the practical side of circular flows. It was one of the key collaborations in addressing technological and networked relationship challenges and some of the organizational challenges. For example, collaboration with external suppliers and service providers allowed firms to pool capabilities, to manage technological uncertainty, and scale operations. These partnerships also helped alleviate pressure on internal resources by distributing the burden of innovation activities. Since no firm has all the required resources and capabilities, having external partnerships proves to be essential to conduct new circular activities (Gadde *et al.*, 2003, Mehmood *et al.*, 2021). Communication in these arrangements took the form of regular meetings, technical coordination, and mutual training sessions, all contributing to more effective implementation of circular processes such as the recovery and refurbishment of components.

Strategic & economic collaboration

This type of collaboration in CSCs took shape through long-term partnerships that transcended transactional coordination. Such alliances were built on shared vision and a common willingness to share both the risks and gains of shifting to CSC. This kind of collaboration entails setting goals in alignment and shared key information in order to assist each other operationally and to showcase the value of collaboration, particularly in the initial stages, where doubt and uncertainty tend to arise. Through these collaborations, actors exchanged information and jointly signaled commitment to circularity. Importantly, these strategic alliances proved especially effective in addressing persistent tensions, those related to market development, regulation, and financial sustainability. Accelerating circular transitions requires collaborative business models and network configurations that support fair value distribution among actors (Ratsimandresy and Miemczyk, 2024, Sudusinghe and Seuring, 2022).

Relational & value-based collaboration

This type of collaboration in CSCs builds trust-based ties and emphasizes shared values and alignment of missions among actors (Ring and Van de Ven, 1994). Trust, built through repeated interactions and relational commitment, provided a foundation for navigating networked

relationship tensions and market development tensions that arose during the circular transition. Some tensions were managed through collaboration built around a shared sustainability mission, where actors related to one another in a partner-like manner rather than through purely transactional exchanges. For instance, an early adopter customer may be willing to pay a higher initial cost or accept a less mature product, motivated by a shared commitment to environmental goals and trust in the supplier's long-term value creation. Over time, the uncertainty and tension between firms about how to work together in a CSC gradually turned into mutual understanding. And in some cases, this even led to new skills or new business possibilities being created. Effectively managed tensions can create innovation and improved processes (Bradford *et al.*, 2004, Burton *et al.*, 2016).

Table *9* presents what has happened in each category of tension at different phases in the vehicle conversion process, from the initial phase through to post-conversion, and the collaborations for the example tensions, adopted from study I. It helps illustrate the temporal and processual nature of CSC development.

Table 9. Tensions and collaborations in three phases of conversion

	Phases		
	Initial Acquisition	Conversion	Post-conversion
Market development	**Tension:** Customer hesitancy to invest due to high initial costs, limited availability of suitable vehicles for conversion	**Tension:** Sharing financial and operational risks associated with vehicle conversions among collaborators	**Tension:** Ensuring vehicles meet market demands, operational needs and economic viability
	Key collaborations: Close collaboration with the customers and marketing partners	**Key collaborations:** Financial partnerships with leasing companies and insurance companies	**Key collaborations:** Continuous feedback loop with customers and service partners
	Implications: Slow initial adoption, constraints on vehicle choice, and increased costs	**Implications:** Increased complexity in financial planning and need for clear risk-sharing agreements	**Implications:** Need for competitive pricing strategies and continuous market assessment
Organizational	**Tension:** Trying different sourcing tactics and collaborating with different suppliers for various parts and second-hand components	**Tension:** Collaborating with external workshops for conversions, services, and paperwork, focusing on developing conversion kits	**Tension:** Setting up effective warranty management systems and processes
	Key collaborations: Collaboration with different suppliers in hardware and software	**Key collaborations:** External workshops and internal engineering team collaborations to align processes and timelines	**Key collaborations:** Internal warranty management teams, and collaboration with external warranty service providers
	Implications: Internal decision-making processes, coordination, and sourcing flexibility	**Implications:** Delays in achieving full collaboration with workshops	**Implications:** Prompt resolution of defects or issues
Networked relationships	**Tension:** Establishing effective communication and trust among actors, aligned expectations	**Tension:** Maintaining strong relationships with customers and suppliers to ensure ongoing satisfaction and support	**Tension:** Managing service and maintenance processes
	Key collaborations: Effective initial communications with customers, suppliers, and financial partners	**Key collaborations:** Effective communications with collaborators in the network	**Key collaborations:** Partnerships with specialized maintenance providers and technology firms
	Implications: Delays in project initiation and potential reduction in trust	**Implications:** facilitate financial arrangements and also support the start-up	**Implications:** Consistent effort and strategic communication

Technological	**Tension:** Finding adaptable vehicles for electric conversion and addressing electronic system complexities	**Tension:** Incompatibility of charging infrastructure and integration of different parts	**Tension:** Maintenance and support to handle technological issues in post-conversion
	Key collaborations: Engaging with initial and alternate vehicle manufacturers, engineering teams, regulatory bodies, and financial partners	**Key collaborations:** Finding charging solutions by collaborating with customers and infrastructure suppliers	**Key collaborations:** Strong partnerships with service providers and ongoing training
	Implications: Increased costs, the need for adaptability, enhanced technical knowledge, and the importance of careful vehicle selection in future projects	**Implications:** Extensive troubleshooting and project delays	**Implications:** Enhanced vehicle data collection and analysis
Regulatory	**Tension:** Obtaining funding from agencies, navigating weight restrictions	**Tension:** Complex and evolving regulatory standards, keeping investors engaged in the project	**Tension:** Handling frequent retesting requirements, support, and following post-conversion regulations
	Key collaborations: Collaboration with funding agencies, electrical safety, and Swedish transport agency	**Key collaborations:** Compliance with regulatory agencies, ongoing communication with funding agencies and investors	**Key collaborations:** Continuous adjustments and interactions with regulatory bodies
	Implications: Delays in vehicle deployment, the need for regulatory compliance, and securing funding	**Implications:** Regulatory compliance requirements, potential delays, ensuring funding and investor requirements are met	**Implications:** Obtaining timely approvals leads to non-compliance issues and additional rework

6. Conclusions

This chapter concludes the thesis by synthesizing the main insights derived from the research. Building on the findings from two studies and the appended papers, the chapter discusses the theoretical contributions, managerial and policy implications, and limitations and future avenues of the research. By addressing the three research questions, the theoretical contributions of this thesis lie in (1) elaborating the multi-actor, networked nature of CSCs, (2) offering a multi-level processual view of how interactions drive circular transitions, (3) providing a typology of tensions in CSCs and a mapping to collaboration strategies, and (4) integrating INA in CE context to highlight the interplay of resources, actors, and activities in transitioning to CSCs. These contributions to the aim of this thesis which is generating knowledge on how business networks contribute to the transition from linear toward CSCs.

6.1. Theoretical contributions

The first contribution of this thesis is extending the emerging body of knowledge on CSCs by characterizing them as dynamic, multi-actor networks where they jointly shape circular outcomes. The findings confirm prior studies on CSCs involving a variety of actors beyond traditional buyer-supplier dyads (De Angelis *et al.*, 2018, Braz and de Mello, 2023), and elaborate this multi-actor nature by showing how a start-up firm and an established SME each engaged a network of partners in their journey toward circularity (Farooque *et al.*, 2019a, Ratsimandresy and Miemczyk, 2024). The findings also contribute to prior studies on start-ups and networks (Baraldi *et al.*, 2019, Melander and Lind, 2022). The thesis adds to the understanding of CSC networks by illustrating the roles and interactions of these varied actors in practice. It highlights that circularity is not achieved by single firms in isolation but through continuous interaction patterns in the network, echoing the industrial network perspective that emphasizes inter-organizational relationships (Håkansson and Snehota, 1995, Huemer and Flygansvær, 2025).

The second contribution of this thesis is a processual and multi-level understanding of how business networks transition toward circularity (Grimm *et al.*, 2024). The processual analysis reveals how interactions at firm, dyadic, and network levels (Melander and Arvidsson, 2021) jointly drive the transition to CSCs, not as a one-off event but an iterative process involving cycles of learning, adaptation, and stabilization across different levels of the network (Sairanen *et al.*, 2024, Huemer and Flygansvær, 2025), by detailing the temporal progression from an exploratory "emerging" phase to a more "established" phase of CSC (Laari-Salmela *et al.*, 2019, Langley *et al.*, 2013). It adds to the theoretical discussions on business network evolution by showing how actor relationships co-evolve with internal organizational routines during a sustainability transition (Ranta *et al.*, 2020, Halinen and Törnroos, 2005, Baraldi *et al.*, 2011). Instead of viewing triggers solely as external shocks (Tollin and Vej, 2012), the findings highlight that interactions themselves can function as triggers for further change.

Third, the thesis contributes to theory by identifying and conceptualizing key tensions that emerge in the formation and development of CSCs, and by linking these tensions to specific collaborative strategies. While the CE literature often discusses general challenges and barriers (de Jesus and Mendonça, 2018, Rizos *et al.*, 2016), this study discusses five interrelated categories of tensions: market-development, organizational, networked relationships, technological, and regulatory tensions and three types of collaborations including operational and supply chain, strategic and economic, and relational and value-based collaborations (Sudusinghe and Seuring, 2022, Batista *et al.*, 2018), mapping between tension types and the key collaboration strategies used to address them.

Finally, this work bridges INA with CE research, contributing to both domains. It demonstrates the usefulness of applying a business network lens to CE challenges, and how inter-organizational relationships facilitate sustainable innovation (Keränen *et al.*, 2023, Bankel and Govik, 2024). Additionally, the thesis enriches the INA literature by providing an empirical context of network change over time with a more radical transition and showing how network change is managed through interactions (Aarikka-Stenroos *et al.*, 2022, Håkansson and Waluszewski, 2013). The research also offers implications for the theory of collaboration governance. It suggests that formal governance mechanisms must be complemented by trust-based governance in networks, extending the argument in the literature that trust is key in uncertain, innovation-driven environments (Arvidsson and Melander, 2020).

6.2. Managerial and policy implications

The insights from this research carry several important implications for managers and practitioners who are involved in developing CSCs. Managers need to adopt a network perspective, recognizing that their firm is part of a larger network of actors that must co-evolve (Möller and Halinen, 1999, Rizos *et al.*, 2016). Practically, investments within relationship-building activities such as the use of intra and extra-firm workshops, company training sessions on circular ways of working, and open information platforms can provide a basis of trust and mutual comprehension (Arvidsson and Melander, 2020). Such trust is important to reduce the considered risks of trying out new CBMs, as partners will be more willing to support each other through the trial-and-error phases of the transition. Also, the study's process perspective suggests that managers should embrace an experimental and iterative approach to implementing circular solutions. It is often more effective to start with small-scale pilot projects or trials (Bocken *et al.*, 2018), serving as learning opportunities and revealing how customers actually use or return products in a circular system.

Another important implication is that the tensions created during the transition towards CSCs need to be detected and handled by managers and not denied or suppressed. Tensions should be dealt with as a sign of the need for a collaborative approach and there lies a possibility of opportunity within. A practical step is to map out potential tension points at the start of a circular initiative. Once tensions are recognized, managers can match them with appropriate collaborative responses.

This thesis also values the engagement with regulatory bodies and policymakers as collaborators rather than just as rule-makers. Managers often view regulation as a fixed external constraint, but the findings from this thesis illustrate that there is room for dialogue and influence by seeking out communication channels with relevant government agencies or industry regulators (Melander and Lind, 2022). While not all regulatory bodies will be flexible, which shows a commitment to societal goals (like emissions reduction) and providing data from pilot successes can persuade authorities to grant exemptions or update rules. For managers, this means devoting time to discussions and perhaps hiring or consulting with experts in regulatory affairs as part of the project team (Rizos *et al.*, 2016).

6.3. Limitations and future research avenues

While this thesis provides insights, it is important to acknowledge its limitations. The contextual conditions are most likely to have shaped the unfolding of CSC initiatives. There are constraints related to data coverage and perspective. Multiple interviews were conducted, but not all relevant network participants could be included, so some viewpoints are missing. Each case also centered on a single focal organization, focusing on the organization's experience over others. In addition, as with any qualitative analysis, interpreting data and identifying themes involved researcher judgment, despite measures like triangulation, some subjectivity in the analysis remains. Also, the analysis was framed primarily by an industrial network perspective and supply chain collaboration frameworks. Other potential theoretical lenses (for example, institutional theory, paradox theory, or power-trust dynamics) were not explicitly applied, which may narrow the interpretation of certain findings.

While this thesis generates knowledge about business networks in CSCs, and how interactions and collaboration mechanisms are critical to circular transitions, there are several possible research opportunities such as examining how external and internal factors are driving CSCs across industries. Future research could build on the role of broader systemic forces and compare different industries or settings to understand how companies adapt their network and collaboration mechanisms depending on the forces they face.

Another possibility is to test the typology of tensions and collaboration strategies that were discussed in this thesis. As an example, the frequency or the levels that these tensions and collaborations are being experienced in various industries or geographies, through surveys or comparative case research to strengthen the generalizability of this research.

Finally, there is an opportunity to apply complementary theoretical lenses to reinterpret or extend the findings. This thesis mainly used the INA and supply chain collaboration literature. Other perspectives, such as institutional theory, could help explain the role of rules and norms, or agency theory to examine incentives and control mechanisms, and when and why those governance modes are chosen between interdependent actors.

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