THESIS FOR THE DEGREE OF LICENTIATE OF ENGINEERING

Dynamics of alignment mechanisms across supply chain tiers in automotive electronics

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Abstract

Research on supply chain alignment has often treated alignment as an achievable state. Evidence from automotive electronics during the 2020–2023 semiconductor shortage and the current shift toward circularity shows that alignment spans multiple tiers among original equipment manufacturers (OEMs), Tier-1, and Tier-2 suppliers and develops over time. Different planning horizons, information access, and responsibilities across tiers create misalignments. The aim of this thesis is to explain how alignment mechanisms emerge, interact, and develop across tiers, using resilience (the shortage) and circularity as the main contexts.

The thesis is based on three studies. The first study identifies misalignments across the OEM–Tier-1–Tier-2 triad and shows a structural change from an open to a transitional triad as a non-contractual alignment mechanism. This structural change reduces some misalignments but also creates new ones, indicating a continuous alignment–misalignment cycle. The second study follows one supply chain from 2020 to 2025 and shows how contractual and non-contractual mechanisms shape alignment over time: while phases of contractual tightening trigger relational responses and vice versa. The third study examines circularity practices and shows that collaboration is the foundation that enables alignment.

The thesis contributes to alignment and multi-tier supply chain management by framing alignment as a continuous process rather than an achievable state; explaining the oscillation between contractual and non-contractual mechanisms over time; showing how transitional triads shift roles and information flows across tiers. Together, the findings suggest that firms should manage different alignment mechanisms simultaneously and anticipate their interactions and unintended consequences.

Keywords: alignment mechanisms; multi-tier supply chain management; automotive electronics; semiconductor shortage; circularity

List of appended papers

Paper I Pasternak, D., Arvidsson, A., and Jonsson P. (2025). *"Misalignments in multi-tier supply chain: An Agency Theory perspective".* Paper manuscript under review in a Journal

An earlier version of the paper was presented at the 34th International IPSERA Conference 2025

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

Paper II Arvidsson, A., Selviaridis, K., and Pasternak, D. (2025). *"The bumpy road to supply chain alignment: Evidence from the European car industry".* Accepted conference paper in the Proceedings of the 33rd EurOMA conference, 13-18 June, Milan.

An earlier version of the paper was presented at the 33rd EurOMA Conference 2025

Contribution: Part of the data collection and analysis, part of interpretation of the results, contributed to writing of the method section.

Paper III Pasternak, D., Arvidsson, A., and Jonsson P. (2025). *"A multi-tier perspective on circularity: Insights from the semiconductor supply chain to automotive".* Accepted conference paper in the Proceedings of the 33rd EurOMA conference, 13-18 June, Milan.

An earlier version of the paper was presented at the 33rd EurOMA Conference 2025

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

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With this thesis, a chapter of my life comes to an end, offering me a moment to reflect on my journey towards my PhD so far. Over two years ago, I moved to Sweden with a single goal: to pursue the highest academic degree. At the time, I did not anticipate that this journey would become much more than an educational pursuit. It has shaped me as a person, by teaching patience and revealing that there is always room for improvement. Much of a PhD is writing. As I have discovered, writing is a form of thinking: through drafting and revising, one continuously refines ideas in an ongoing loop. Feedback from those around me has been essential in this process.

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Dawid Pasternak
Gothenburg, September 2025

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1. Introduction

1.1. Theoretical background

Supply chain management as a discipline is primarily concerned with the management of inter-organizational relationships to improve performance for the entire supply network. One of the central aspects to this endeavor is the concept of supply chain alignment (Halldorsson *et al.*, 2007; Lee, 2004). Supply chain alignment refers to a state of harmony in terms of objectives, structures, and processes, both within a firm's functional departments and between different actors in a supply chain (Hou *et al.*, 2024; Skipworth *et al.*, 2015; Wong *et al.*, 2012). When alignment is achieved, each firm's decisions complement the others, rather than causing counter-productive effects. Conversely, misalignment arises when objectives and decisions are not coordinated: what is optimal for one firm may undermine another, leading to inefficiencies or conflicts (Skipworth *et al.*, 2015). The need for alignment is considered indisputable. Yet achieving harmonious relationships among multiple firms is difficult, which is why alignment remains a major challenge in supply chain management (Wong *et al.*, 2012).

The prevailing alignment paradigm is predominantly dyadic or focal-firm-centric perspective being a limitation in literature (Alqahtani *et al.*, 2024; Lyons and Ma'aram, 2014). Additionally, research in the field of supply chain management has concentrated on the dyadic relationship between a focal company and its direct, first-tier suppliers, often overlooking the complex web of relationships that exist further upstream (Kusi-Sarpong *et al.*, 2023; Marttinen and Kähkönen, 2022; Swierczek and Szozda, 2023). This narrow focus is increasingly insufficient in an era of globalized, fragmented, and multi-tiered supply networks.

A multi-tier supply chain management literature extends beyond the immediate (Tier-1) suppliers to include their suppliers (Tier-2), the suppliers of those suppliers (Tier-3), and so on (Mena *et al.*, 2013). This structure, while providing strategic depth and access to global resources, introduces challenges in management and alignment (Gong *et al.*, 2023; Grimm *et al.*, 2023). The complexity of multiple suppliers escalates due to difficulties in integrating data of different actors, fostering collaboration with distant and often unknown partners, and ensuring the adoption of consistent standards and technologies across all tiers (Kembro *et al.*, 2025). A disruption at a lower-tier supplier, such as a Tier-2 component manufacturer, cascades up the chain to interrupt the focal firm's operations (Faruquee *et al.*, 2025), showing a lack of alignment at deeper tiers is not a distant concern but a direct and serious threat.

This multi-tier literature problematizes the notion of a single, uniform alignment, additional concept showing the complexity is the "double agency role" of the first-tier supplier (Wilhelm *et al.*, 2016). In this role, a Tier-1 supplier must act as an agent for the lead firm, implementing its standards (e.g., for sustainability or quality), while simultaneously acting as a principal toward its own Tier-2 suppliers, cascading those same requirements downward. The alignment objectives between the Tier-1 and Tier-2 suppliers (often driven by cost and operational efficiency) may conflict with the alignment objectives between the lead firm and the Tier-1 supplier (which may be driven by sustainability compliance or innovation).

The second limiting perspective in supply chain management literature is static conceptualization of alignment as state of harmony, overlooking the dynamic, emergent, and often messy reality of inter-firm relationships (Grimm and Reinecke, 2024; Wieland, 2021). Pioneering work by Selviaridis and Spring (2018) explicitly conceptualizes supply chain alignment as a process, not a state. Alignment does not happen automatically or instantaneously, it is dynamic: firms must keep working on it, and it changes as conditions evolve over time. Additionally, every effort towards alignment can trigger new misalignment (Lundin and Norrman, 2010). Recent studies underscore alignments processual character and must be continuously negotiated and built through iterative governance adjustments (Alqahtani *et al.*, 2024).

1.2. Strategic contexts of alignment: resilience and circularity

To fully grasp the nature of alignment, it is instructive to examine how it manifests in pursuit of different strategic objectives (Chatha and Butt, 2015; Vachon *et al.*, 2009). The parallel yet distinct goals of supply chain resilience and supply chain circularity provide two suitable empirical contexts for this exploration. First, supply chain resilience is concerned with the ability of a supply chain to prepare for, withstand, adapt to, and recover from disruptions in a timely and efficient manner (Pettit *et al.*, 2010). In this context alignment is important because in a crisis e.g. misaligned incentives can lead partners to act in their own self-interest (Lee, 2004). Therefore, alignment for resilience manifests in several ways, e.g.: as companies must align their operations and strategies to strategically position safety stock, build in excess production capacity, or pre-qualify alternative suppliers (Yang *et al.*, 2024); to ensure partners remain committed during a crisis, their interests must be aligned (Faruquee *et al.*, 2025).

In direct contrast to the reactive nature of resilience, supply chain circularity is a proactive strategy aimed at the redesign of the entire economic system (Batista *et al.*, 2023). The push for businesses to adopt circularity which has grown in recent years requires alignment between different actors of the supply chain (Calzolari *et al.*, 2024). Yet, current circular practices remain fragmented across functional areas and geographic regions (Bocken *et al.*, 2025). One of the major challenges arises from management of dependencies with different supply chain actors upstream and downstream (Gebhardt *et al.*, 2022). Further, circularity begins at the design stage. Achieving it requires deep alignment on "design for circularity" principles, necessitating collaboration between focal firm's, its suppliers, and its downstream partners (Zils *et al.*, 2025). Therefore, alignment goes beyond traditional relationships or those are altered to align with circularity (Sarja *et al.*, 2025). Finally, for a circular system to function, all participating actors must have a clear incentive to participate requiring aligning of incentives, value propositions and financial models (Van Opstal *et al.*, 2024).

Contemporary supply chain management faces challenges as a result of these two imperatives: building resilient supply chains capable of withstanding disruptions while simultaneously transitioning toward circularity. Both require capabilities that traditional dyadic, cost-focused approaches cannot deliver, visibility across multiple tiers, collaboration beyond immediate suppliers, and dynamic alignment processes that adapt to changing conditions.

The intersection of these challenges becomes particularly acute in industries characterized by high technological complexity, extended supply networks, and rapid change. The automotive industry's dependence on electronic components demonstrates this complexity, where achieving alignment across multiple tiers is no longer optional but essential for both operational continuity and strategic transformation.

1.3. Empirical background

The automotive industry's relationship with electronic components has undergone a transformation over the past decade. Prior to 2020, automotive OEMs had perfected a sourcing model that epitomized efficiency: comprehensive outsourcing to Tier-1 suppliers who managed the complexity of electronic systems as integrated "black boxes" (Bennett and Klug, 2012; Garcia *et al.*, 2024). This model allowed OEMs to focus on vehicle integration and assembly while delegating component design, sourcing, and supply chain management to specialized suppliers.

This outsourcing approach aligned perfectly with the automotive industry's lean manufacturing philosophy. OEMs maintained minimal inventory levels and relied on just-in-time delivery from Tier-1 suppliers who orchestrated the upstream supply network (Mönch *et al.*, 2018). The model's efficiency was undeniable: it reduced capital requirements, simplified procurement processes, and allowed OEMs to leverage their Tier-1 suppliers' specialized knowledge without developing internal expertise in rapidly evolving electronic technologies.

However, beneath this operational efficiency, a shift was occurring. The electronics content in vehicles has exploded from less than 5% of total vehicle value in 1970 to 35% by 2020, with projections reaching 45-50% by 2030 (Burkacky *et al.*, 2023; Placek, 2023). Modern vehicles now contain over 3,000 semiconductor chips controlling everything from engine management to infotainment systems which are embedded in automotive electronics. Electric vehicles require up to 11 times more semiconductors than their internal combustion counterparts (Arora *et al.*, 2022; Brinley, 2023).

This exponential growth in electronic content occurred gradually enough that OEMs could maintain their traditional sourcing model without changes. Tier-1 suppliers absorbed the increasing complexity, managing relationships with semiconductor manufacturers, electronic manufacturing services (EMS) companies, and component distributors. OEMs remained largely disconnected from the semiconductor industry, viewing electronics as standardized components within modules rather than strategic inputs requiring direct management attention (Garcia et al., 2024).

Simultaneously, regulatory pressures began reshaping the automotive landscape. The European Union's emissions standards drove rapid electronification as manufacturers required sophisticated engine control units, exhaust treatment systems, and hybrid powertrains to meet increasingly stringent targets (European Commission, 2022). The EU Battery Regulation (2023/1542) introduced requirements for battery passports and recycled content that would necessitate unprecedented supply chain transparency by 2027 (European Parliament and Council, 2023). The emerging circular economy agenda, formalized in the EU Circular Economy Action Plan (European Commission, 2020), pushed manufacturers toward design for disassembly, material recovery, and extended producer responsibility, all requiring deeper visibility into component composition and

supplier practices (European Commission, 2023). These sustainability pressures created new demands for supply chain collaboration that the traditional Tier-1 centric model struggled to accommodate. Achieving circularity objectives requires engagement across multiple tiers to ensure material traceability, implement take-back systems, and redesign components for remanufacturing. Yet OEMs lacked direct relationships with the semiconductor and component manufacturers whose participation would be essential for circular practices (Gebhardt, Kopyto, *et al.*, 2022).

The semiconductor shortage of 2020-2023 exposed the vulnerabilities inherent in automotive electronics supply chains. When COVID-19 initially suppressed automotive demand, OEMs reflexively canceled semiconductor orders following their just-in-time principles. Semiconductor manufacturers, operating differently require 85%+ capacity utilization for profitability, immediately reallocated this capacity to booming consumer electronics demand (Burkacky *et al.*, 2022). When automotive demand recovered faster than anticipated, within months rather than the expected years, semiconductor capacity was already committed elsewhere.

The consequences were catastrophic. Global automotive production fell by 9.5 million vehicles in 2021 and another 3 million in 2022, with revenue impacts exceeding $210 billion (Brinley, 2023). Automotive OEMs worldwide idled its plants and stored thousands of partially completed vehicles awaiting chips, shut down facilities or operated at partial capacity for months (Ludwikowski and Sjoberg, 2021). More troubling than the immediate production impacts were the structural misalignments the crisis revealed. Semiconductor lead times, typically 12-16 weeks, extended beyond 52 weeks for some components. The automotive industry's 2-3 month planning horizons proved wholly inadequate for semiconductor procurement, where capacity decisions require 3-5 year commitments and new fab construction costs $10-20 billion (Nellis, 2021). The misalignment between industries: automotive's variable, short-term demand patterns versus semiconductors' requirements for stable, long-term commitments (Zapp *et al.*, 2012); created coordination failures that no amount of crisis management could resolve.

The crisis also revealed important knowledge gaps. Many OEMs discovered they had no visibility into which semiconductors were used in their vehicles beyond generic part numbers. When specific chips became unavailable, neither OEMs nor many Tier-1 suppliers possessed the technical knowledge to identify alternatives or redesign systems. The "black box" approach that had enabled efficient outsourcing became a liability when transparency and technical understanding were urgently needed (Automotive Logistics & Supply Chain, 2023; Garcia *et al.*, 2024). Geographic concentration risks compounded these challenges. The automotive industry discovered that 60% of semiconductor assembly and testing occurred in Southeast Asia, Taiwan alone accounts for 92% of advanced semiconductor manufacturing capacity through TSMC. Natural disasters or geopolitical tensions in these concentrated locations could, and did, paralyze global automotive production (Xiong *et al.*, 2025).

In response, OEMs began establishing direct relationships with semiconductor manufacturers for the first time, creating semiconductor task forces and later dedicated semiconductor procurement teams. Some OEMs signed direct supply agreements with semiconductor manufacturers, bypassing traditional Tier-1 intermediation for strategic

components. This structural shift challenges the traditional structure of automotive supply chains, requiring new capabilities, governance mechanisms, and collaboration with lower tier suppliers (Garcia *et al.*, 2024).

Yet these reactive measures address symptoms rather than root causes. The challenge remains: how can two industries with different business strategies, planning horizons, and operational philosophies achieve the alignment necessary for both resilience and innovation? The semiconductor content in vehicles will increase and regulatory requirements for circularity will intensify. This context demands more than incremental adjustments to existing practices. It requires reimagining how alignment can be achieved and maintained across multiple tiers of supply chain, characterized by technological complexity, regulatory pressure, and operational differences. Understanding how such alignment emerges, operates, and develops becomes essential not just for managing current disruptions but for enabling the automotive industry's transformation toward an electrified, autonomous, and circular future.

1.4. Purpose and research questions

Motivated by the empirical problems of planning horizon mismatch between automotive and semiconductor industries, visibility gaps from Tier-1 outsourcing, growing electronics content, sustainability regulations and by the literature's dyadic bias, static view of alignment, and limited understanding of cascading multi-tier effects (e.g., the Tier-1 double-agency role). This thesis examines alignment as a dynamic process, in terms of changing over time, for multi-tier supply chain management, particularly how firms align across multiple tiers to address problems the automotive electronics supply chain is facing. While existing literature has examined alignment primarily through static, dyadic perspectives (Skipworth *et al.*, 2015; Wong *et al.*, 2012), we lack understanding of alignment dynamics through various mechanisms across multiple supply chain tiers over time.

This processual gap is important because alignment is not achieved once but must be continuously worked on through different mechanisms, both contractual (e.g., agreements, formal governance) and non-contractual (e.g., information sharing, collaboration), that may reinforce or undermine each other (Lundin and Norrman, 2010; Selviaridis and Spring, 2018). Supply chain alignment mechanisms are the intentionally designed contracts, processes, structures or relationship norms that firms employ to coordinate objectives, reduce misalignments, and maintain harmony across multiple levels (incentive, functional, operational, and strategic) between supply chain actors (Norrman and Naslund, 2019; Roehrich *et al.*, 2020; Selviaridis and Spring, 2018).

Furthermore, contemporary supply chains face dual pressures that demand multi-tier coordination: sudden disruptions requiring rapid realignment for resilience, and sustainability transitions requiring redesign for circularity. Both contexts expose how alignment mechanisms must not only emerge in response to triggers but also interact across tiers and develop as conditions change.

Therefore, the purpose of this thesis is to contribute to the supply chain alignment literature by explaining how alignment mechanisms emerge, interact, and develop in multi-tier supply chain management. By using the empirical contexts of the semiconductor shortage crisis and circularity transitions in automotive electronics as

settings for understanding these dynamic processes. To achieve this purpose, this thesis will address the following research questions:

RQ1: How are misalignments characterized and what alignment mechanisms are employed across multiple tier automotive electronics supply chain?

The first research question addresses the understanding of misalignments, how they manifest in managing multi-tier supply chain. To improve the alignment mechanisms, it is necessary to understand what the misalignments are, to handle them accordingly to their root causes. Understanding the current state of misalignments and mechanisms provides a foundation, but alignment is not static. The dynamic nature of alignment (Selviaridis and Spring, 2018) suggests that mechanisms interact and develop over time, potentially creating new misalignments even as they resolve others (Lundin and Norrman, 2010). To capture this dynamic interplay, the second research question examines:

RQ2: How do alignment mechanisms develop and interact over time across multiple tiers in automotive electronics supply chain?

This research question examines the evolution of alignment over time, particularly how contractual and non-contractual alignment mechanisms interplay and develop supply chain alignment. It is important to understand which alignment mechanisms develop the alignment in what way, leading to more alignment or new misalignments. This question highlights the processual nature of alignment and implications of each corrective action.

Alignment in the supply chain refers to the state where all supply chain actors share common goals and objectives, ensuring everyone is working towards the same overarching vision. This is achieved by collaboration, the process of actively working together, sharing information and coordinating activities to achieve those aligned goals between different supply chain actors. While various alignment mechanisms exist, collaboration emerges as a foundational process enabling effective alignment. This is important for addressing complex, strategic pursuits like resilience or transitions towards circularity (Braz & de Mello, 2024). Circularity requires unprecedented coordination across tiers - from design decisions at OEMs through to material choices at semiconductor manufacturers. Yet we know little about how collaboration enables alignment when pursuing such systemic changes.

Together, these questions progress from understanding the misalignments and mechanisms, through examining their dynamics, to investigating how specific mechanisms work towards alignment for resilience and circularity.

1.5. Papers

To investigate how alignment mechanisms emerge, interact, and develop in multi-tier supply chain management, this thesis employs three complementary studies. Each paper examines different aspects of alignment mechanisms while building insights from the others, creating a coherent progression from identifying misalignments to understanding alignment mechanisms dynamics and their foundation. Figure 1 illustrates how this thesis is organized around three inter-related papers. Each of the Papers is moving from an observed empirical context of automotive electronics supply chain (in strategic context of alignment for resilience and circularity) through a guiding lens (theoretical

perspective) to a scholarly conversation (Literature on alignment and multi-tier supply chain management).

Paper I establishes the empirical foundation in context of resilience by mapping misalignments across the OEM–Tier-1–Tier-2 triad during the semiconductor crisis. Using agency theory as an analytical lens, it studies four types of misalignments (incentive, functional, operational, strategic) and documents initial alignment mechanisms employed as structural changes. Specifically, the formation of transitional triads. This typology of misalignments and the finding of how structural changes create new misalignments while resolving others directly informs Paper II's dynamic process perspective.

Paper II complements Paper I's insight in context of resilience on how alignment mechanisms create cyclical patterns by adopting a longitudinal lens (2020-2025). It traces how contractual and non-contractual mechanisms interact over time, with the lens of a dialectical process where formal controls trigger relational responses and vice versa. This processual understanding deepens Paper I's snapshot by showing how the transitional triads identified in Paper I develop through alternating phases of contractual tightening and relational repair.

Paper III focuses on collaboration as a foundation of alignment mechanisms in the context of circularity. While Papers I and II focused on resilience-driven alignment which is more reactive nature to the disruption, Paper III examines how collaboration enables proactive alignment for strategic goals.

Finally, the three Papers in this thesis collectively advance our understanding of alignment mechanisms in multi-tier supply chain management. Through complementary theoretical and empirical contributions firms can improve their alignment through orchestrating different alignment mechanisms suited to varying strategic contexts.

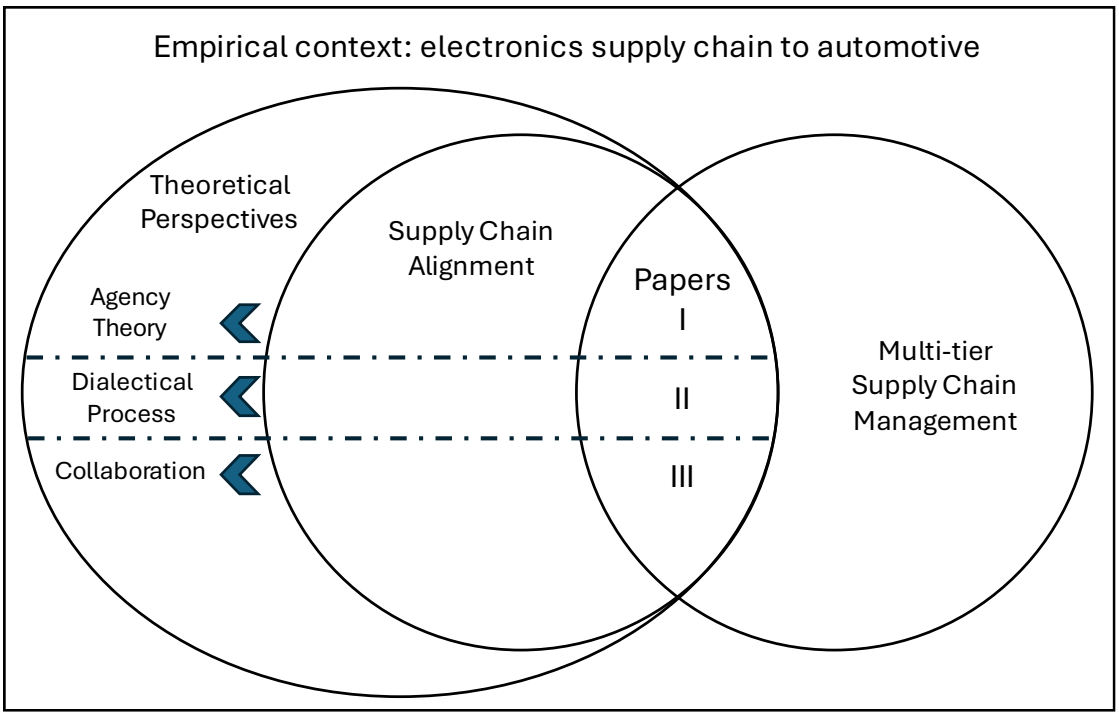

Figure 1: Overview of empirical context, theoretical perspectives, literature, and paper of this thesis

1.6. Thesis outline

This thesis is structured as a compilation thesis (kappa) with three appended papers. The following sections guide the reader through the theoretical foundations, methodological approach, empirical findings, and contributions of this research.

Chapter 2: Theoretical Framework establishes conceptual foundations by integrating relevant literature. First, it presents supply chain alignment literature, distinguishing between static views and processual perspectives. Second, it examines multi-tier supply chain management, focusing on triadic structures and governance mechanisms beyond the dyad. Third, it introduces agency theory as an analytical lens for understanding misalignments in multi-tier settings. The chapter concludes with an integrative framework that guides empirical investigations.

Chapter 3: Research Methods presents the methodological approach adopted across the three studies. It begins with the philosophical foundations of critical realism and justifies the case study approach for investigating multi-tier supply chain alignment. The chapter details the research process, including case selection, data collection, secondary sources, and analytical techniques combining qualitative coding with analysis. Reflections on research quality are addressed in the last section.

Chapter 4: Summary of Appended Papers provides an overview of the three empirical studies. Paper I diagnose misalignments during the semiconductor crisis using agency theory. Paper II traces the evolution of alignment mechanisms longitudinally from 2020-2025. Paper III examines collaboration as the foundation of alignment mechanisms for circularity. Finally, a conclusion on how the papers build on each other conceptually and methodologically to address the research questions.

Chapter 5: Discussion integrates empirical findings to advance theoretical understanding of alignment mechanisms in managing multi-tier supply chains. The chapter synthesizes how misalignments emerge through structural change (Paper I), develop through dialectical interactions between contractual and non-contractual mechanisms (Paper II), and can be proactively managed through collaboration foundations for strategic objectives (Paper III). The discussion demonstrates that effective multi-tier alignment requires orchestrating multiple mechanisms simultaneously while accepting that perfect alignment remains elusive in technologically complex supply chains.

Chapter 6: Concluding Remarks the theoretical contributions to alignment and multi-tier supply chain management literatures. Practical implications for managing alignment in technologically complex supply chains are presented. The chapter concludes with limitations and future research directions.

2. Theoretical framework

2.1. Supply chain alignment

Supply-chain alignment can be understood as the ongoing pursuit of fit between objectives, structures and processes not only within individual firms but across multiple tiers of a supply network. Building on previous work in the field of supply chain management (Agndal *et al.*, 2023; Kumar *et al.*, 2020; Selviaridis and Spring, 2018; Skipworth *et al.*, 2015; Wong *et al.*, 2012), this thesis treats alignment as a four-level construct (incentive, functional, operational and strategic) that must be simultaneously maintained inside organizations and between them. When those levels are in sync, supply chains redistribute risks, costs and benefits more equitably, promote transparent information exchange and ultimately deliver desired performance to end customers (Lee, 2004; Selviaridis and Spring, 2018).

Yet misalignments are not the exception. This misfit in objectives, structures and processes arise in the literature from four levels: Incentive misalignments arise from hidden actions, hidden information or poorly designed incentives, creating free-riding, risk-shifting and opportunism (Bimpikis *et al.*, 2018; Ganesh *et al.*, 2014; Narayanan and Raman, 2004). Functional misalignments appear when different functions as sales, purchasing and supply-chain teams chase conflicting KPIs or speak different "languages", strangling collaboration (Chehbi-Gamoura *et al.*, 2020; Kumar *et al.*, 2020). Operational misalignments surface in capacity allocation, lead-time setting or performance measurement systems that no longer match the environment they operate in (Hyndman *et al.*, 2014; Wu *et al.*, 2014). Strategic misalignments emerge when the business strategy says "cost-leadership" but supply-chain relationships are managed as if product differentiation mattered more, or vice-versa, undercutting competitiveness (Dangol *et al.*, 2024; McAdam *et al.*, 2014). The problem is amplified in contemporary, multi-tier settings such as automotive semiconductors, where the focal firm depends on organizations it cannot see, let alone govern directly (M. Tachizawa and Yew Wong, 2014; Mena *et al.*, 2013; Wilhelm *et al.*, 2016).

To reach alignment scholars propose various strategies better contracts, richer data sharing, cross-functional integration workshops, trust-building routines, adaptive control systems (Alexander *et al.*, 2018; Narayanan and Raman, 2004; Van Hoek and Mitchell, 2006). Most of the classic literature views alignment as a static state, the outcome of choosing the "right" alignment mechanism given the problem (Lee, 2004; Skipworth *et al.*, 2015). However, well-intended "fixes" as a new contract, structural or processual change, can cause new misalignment elsewhere in the supply chain (Lundin and Norrman, 2010) because interdependencies far beyond a dyad (Mena *et al.*, 2013). Therefore, a growing stream of literature therefore reframes alignment as a process shaped by contracting, learning and relationship realignment over time (Selviaridis and Spring, 2018). By tracing how contracts are rewritten, co-developed and governance adjusted, literature shows that alignment is never fully achieved; it is worked on through cycles of experimentation, evaluation and re-alignment. Consequently, framing alignment as a dynamic, multi-tier negotiation managed through a bundle of interacting mechanisms (Agndal *et al.*, 2023).

2.2. Alignment mechanisms

While alignment represents the desired state of harmony in supply chains, achieving and maintaining this state requires active intervention through various mechanisms. Supply chain alignment mechanisms are the contracts, processes, and arrangements firms use to address misalignments to improve collaboration across different supply chain actors (Norrman and Naslund, 2019; Roehrich *et al.*, 2020; Selviaridis and Spring, 2018). Following theoretical developments in multi-tier supply chain management, this thesis distinguishes between contractual mechanisms (formal, legally binding arrangements) and non-contractual mechanisms (informal practices, relational practices, structural arrangements), while recognizing collaboration as the foundational process that enables both types to function effectively.

2.2.1. Contractual alignment mechanisms

Contractual mechanisms encompass formal governance structures that specify rights, obligations, and coordination procedures between supply chain members. Contractual alignment mechanisms have developed from simple transactional agreements to sophisticated coordination tools. These mechanisms provide the legal framework for alignment through several instruments: performance-based contracts with explicit metrics and penalties (Selviaridis and Wynstra, 2015); risk-sharing arrangements that distribute uncertainty between partners (Zhu *et al.*, 2022); information disclosure requirements and data-sharing protocols; and capacity reservations with volume commitments (Wu *et al.*, 2014).

In the context of automotive electronics, contractual mechanisms traditionally governed dyadic relationships between OEMs and Tier-1 suppliers. These contracts typically emphasized flexibility and cost efficiency, with minimal volume commitments allowing OEMs to adjust orders based on market demand (Bennett and Klug, 2012). However, the semiconductor shortage of 2020-2023 revealed limitations of these contractual approaches when applied to multi-tier contexts. The misalignment between automotive contracts requiring short-term flexibility and semiconductor industry norms demanding long-term capacity commitments created cascading misalignments throughout the supply network (Garcia *et al*., 2024). This limitation of purely contractual approaches becomes particularly acute when managing relationships across multiple tiers with divergent business logics and planning horizons.

2.2.2. Non-contractual alignment mechanisms

Non-contractual mechanisms represent a broad category of governance arrangements that operate outside formal legal frameworks to enable supply chain coordination. Non-contractual mechanisms operate outside formal legal frameworks to enable coordination through structural and relational means. These mechanisms have gained prominence as firms recognize that contracts are necessarily incomplete and cannot specify appropriate responses to all contingencies in supply networks characterized by uncertainty, complexity, and interdependence (Poppo and Zenger, 2002; Roehrich *et al.*, 2020). This has been extensively validated in supply chain research, with meta-analyses confirming that relational governance significantly enhances performance beyond what contracts alone achieve (Cao and Lumineau, 2015).

Structural changes as mechanisms involve modifications to supply network structure and organizational design. Whereas supply network reconfiguration represents structural change. The transition from open to closed or transitional triads alters information flows and power dynamics throughout the supply network (Choi and Wu, 2009; Mena *et al.*, 2013; Yang *et al.*, 2022). In transitional triads, focal firms establish direct but informal links with lower-tier suppliers while maintaining existing intermediary relationships (Mena *et al.*, 2013). Research demonstrates that these structural changes reduce information asymmetry and enable better coordination, though they also create new challenges such as role ambiguity for intermediaries (Villena and Gioia, 2018; Yang *et al.*, 2022). The effectiveness of triadic structures depends on factors including product complexity, supplier capabilities, and environmental uncertainty (Choi *et al.*, 2021).

Further relational mechanisms build on social capital to enable coordination through trust, reciprocity, and shared understanding (Carey *et al.*, 2011). Empirical research identifies several relational mechanisms: regular multi-party meetings that bring together actors from different tiers; informal information sharing beyond contractual requirements; joint problem-solving sessions during disruptions; knowledge exchange initiatives including technical training and best practice sharing; and relationship-specific investments in communication systems and processes (Villena *et al.*, 2011). Recent research emphasizes that information sharing across multiple tiers should be done only during limited period (Kembro *et al.*, 2025). These relational mechanisms prove particularly valuable during periods of environmental turbulence, when formal contracts cannot adequately specify appropriate responses.

2.2.3. Collaboration as foundation of alignment mechanisms

While contractual and non-contractual mechanisms provide the archetypes of alignment mechanisms. This thesis adopts collaboration (what firms do) as foundation, rather than treating collaboration as merely another mechanism. Like contemporary research positions it as the foundational process enabling effective multi-tier alignment, being described as precondition to e.g. information sharing, goal congruence, decision synchronization, incentive alignment. (Cao and Zhang, 2011; Soosay and Hyland, 2015). Collaboration in supply chains represents a partnership process where two or more autonomous firms work closely to plan and execute supply chain operations toward common goals and mutual benefits (Cao and Zhang, 2011). Unlike alignment mechanisms that can be unilaterally imposed, collaboration requires voluntary participation and mutual adjustment to work across boundaries to achieve objectives impossible independently (Soosay and Hyland, 2015).

In multi-tier contexts, collaboration transforms alignment mechanisms from static governance tools into dynamic coordination processes. For instance, contractual provisions for information sharing remain ineffective without collaboration that specify what information to share, when, and how to act upon it (Cao and Zhang, 2011). Further, in multi-tier contexts, collaboration serves multiple important functions. First, it bridges contractual gaps by enabling mutual adjustment when unforeseen circumstances arise. The automotive semiconductor crisis demonstrated how collaboration with lower tier suppliers enabled rapid adaptation when formal contracts proved inadequate (Garcia *et al.*, 2024). Second, collaboration facilitates structural changes by building the trust necessary for successful transitional triads. Without collaboration foundations, direct

OEM-semiconductor supplier links remain superficial and fail to achieve intended coordination benefits (Yang *et al.*, 2022). Third, collaboration creates system-wide understanding essential for multi-tier alignment, helping actors comprehend implications beyond their immediate dyadic relationships (Gong et al., 2018).

2.3. Multi-tier supply chain management

Research on supply-chain organization has progressively moved beyond the dyadic buyer–supplier lens to recognize that exchanges are embedded in multi-tier configurations. Multi-tier supply-chain management designates the triad, comprising a focal buyer, a first tier (Tier-1) supplier and that supplier's supplier (Tier-2), as the analytical unit, because it is at this interface that information, material and power intersect (Choi & Wu, 2009). Multi-tier supply chains consist of various tiers, including direct suppliers and sub-suppliers, creating a web of relationships that can influence performance and sustainability outcomes (Gong *et al.*, 2021; Mena *et al*., 2013). Supply chain management research has elaborated a structural taxonomy of triads that differentiates between open, transitional and closed arrangements, thereby linking network topology to coordination and performance outcomes (Mena *et al*., 2013).

In an open triad the focal firm has no direct link to Tier-2; information and materials flow linearly through Tier-1, which acts as an intermediary. At the opposite end of the taxonomy, a closed triad establishes dyadic ties among all three actors, allowing direct communication, data exchange and, where required, contractual relations between the buyer and Tier-2. Between these poles lies the transitional triad, in which the buyer has an informal link to Tier-2, for example through technical audits or directed-sourcing mandates, without fully displacing Tier-1's intermediary role (Choi and Hong, 2002; Mena *et al.*, 2013).

Recent studies indicate that transitional or closed triads can generate measurable efficiency gains. Direct buyer assurances or training of Tier-2 suppliers reduce information asymmetry, re-align incentives and improve total channel profit even in the absence of formal tripartite contracts (Gong *et al.*, 2018; Heydari *et al.*, 2019). Moreover, early Tier-2 involvement has been linked to accelerated product and process innovation (Falcone *et al.*, 2025) and to improved traceability in circular-economy initiatives, where rapid feedback on material provenance is important (Falcone and Tutore, 2025).

2.4. Theoretical perspectives adopted in Papers

2.4.1. Agency theory

Agency theory provides a direct explanation for why alignment problems arise in supply chain relationships. At its core the theory treats every supply chain transaction as a principal–agent relationship in which one party (the principal) delegates a task to another (the agent) under conditions of goal incongruence, information asymmetry and risk-preference differences (Eisenhardt, 1989). These are exactly the root causes that the alignment literature flags as "incentive misalignments" (Narayanan and Raman, 2004; Skipworth *et al*., 2015) e.g.: hidden information fuels forecasting bias, goal incongruence between actors, and divergent risk aversion in capacity or sourcing decisions. By translating such frictions, agency theory offers a vocabulary for specifying where misalignment sits and which governance mechanisms could correct it.

Empirical supply chain research has repeatedly demonstrated the diagnostic and prescriptive power of the agency lens (Matinheikki *et al*., 2022). Studies show that contracts, quantity-flexibility options and buy-back schemes each eliminate specific agency losses by reallocating risk and information (Cachon and Lariviere, 2005). Further, supplier-development programs are most effective when the focal firm ties training or technology support to explicit performance contingencies, thereby aligning effort with payoff (Selviaridis and Wynstra, 2015). More recently, studies of multi-buyer "assessment-sharing alliances" show that when several principals pool audit data they both reduce monitoring cost and increase agents' information advantage (Lechler *et al.*, 2019). All these results stem directly from agency theory's basic idea: aligning everyone's incentives.

The theory is equally well suited to the multi-tier supply chains that dominate contemporary supply networks. Extensions such as double-agency and multiple-principal models elucidate how first-tier suppliers can act simultaneously as agents of focal firms and as principals to their own sub-suppliers, creating cascading goal conflicts and information bottlenecks (Forslund *et al.*, 2021; Wilhelm *et al.*, 2016). Triadic analyses reveal that directed-sourcing programs, in which the buyer reaches over Tier-1 to coach or certify Tier-2, work precisely because they dismantle the information monopoly that the intermediary would otherwise exploit (Mena *et al*., 2013; Yang *et al.*, 2024). In this way agency theory not only predicts whether a structural shift from open to closed triads will improve alignment but also predicts the contractual safeguards (e.g., pass-through incentives, joint auditing rights) required to prevent new forms of opportunism.

Finally, the agency perspective integrates naturally with the dynamic, process-oriented view of alignment. Because the theory models governance choice as contingent on monitoring cost, outcome uncertainty and risk distribution it can be applied longitudinally to trace how contracts and relational mechanisms are renegotiated over time (Selviaridis and Spring, 2018). Studies of resilience and circularity show, for example, that buyers relax pure output-based contracts after a disruption in favor of behavior-based clauses and joint-investment agreements, thereby re-balancing risk and information as circumstances change (Cao *et al.*, 2021; Mena and Schoenherr, 2023). Therefore, agency theory sees these changes as natural reactions to shifting alignment conditions, exactly what this thesis seeks to show when it traces how alignment efforts manifest, interact, and develop alignment in multi-tier supply chains.

2.4.2. Dialectical process

While agency theory provides insights into the structural sources of misalignment, understanding how alignment develops over time requires a processual lens. Dialectical process theory, as articulated by Van de Ven and Poole (1995), offers a framework for analyzing how contradictory forces drive organizational change through cycles of thesis, antithesis, and synthesis. Unlike teleological models that assume goal-directed change or evolutionary models that emphasize competitive selection, the dialectical motor of change posits that organizations exist in a pluralistic world where opposing forces collide and compete for domination (van de Ven and Poole, 1995). This perspective proves particularly valuable for understanding supply chain alignment, where firms must continuously navigate tensions between competing demands that cannot be permanently resolved but must be dynamically managed.

The dialectical motor operates through the confrontation of opposing forces that are simultaneously interdependent and mutually negating. As Van de Ven and Poole (1995) explain, these forces exist in a state of creative tension where the thesis (an existing condition or practice) encounters its antithesis (a contradictory force or demand), generating conflict that requires resolution through synthesis. However, this synthesis does not represent a final state but rather becomes a new thesis that will inevitably encounter its own antithesis, perpetuating cycles of change. In supply chain contexts, this manifests as persistent tensions between flexibility and stability, autonomy and dependence, or competition and cooperation that drive continuous adaptation (Putnam *et al.*, 2016).

Recent applications of dialectical thinking to supply chain management, though limited, demonstrate its explanatory power. Viewing automotive OEM's post-acquisition journey through a dialectical-process lens, Dattée et al. (2022) show that subsidiary autonomy doesn't align in one-way but oscillates, creating a bounded "harmonic domain" in which autonomy can swing between more autonomy and less autonomy without collapsing the relationship. This study transform dialectics from an abstract thesis-antithesis metaphor into a concrete process model theorizing recurrent organizational tensions extending dialectical process theory to explain why structures keep misaligning instead of settling in alignment (Dattée *et al.*, 2022). More recently, studies employing paradox theory, which share conceptual foundations with dialectical perspectives, have identified multiple contradictory tensions in supply chain management. Kocabasoglu-Hillmer et al. (2023) documented how firms must simultaneously pursue competing objectives like efficiency versus resilience. These tensions cannot be eliminated but must be embraced as inherent features of complex inter-organizational relationships (Kocabasoglu-Hillmer *et al.*, 2023).

In multi-tier supply chains, dialectical tensions multiply as each tier faces its own set of contradictions while managing relationships both upstream and downstream. Zehendner et al. (2021) found that sustainability demands create cascading dialectical tensions throughout electronics supply chains, with each tier experiencing different manifestations of the economic-environmental paradox (Zehendner *et al.*, 2021). The automotive industry exemplifies these dynamics particularly well, as suppliers face the "proximity paradox", simultaneous pressures for cost-efficient centralized production and customer-responsive local manufacturing. This contradiction drives continuous oscillation between global integration and local responsiveness strategies (Bauernhansl *et al.*, 2020).

The dialectical lens reveals alignment not as a stable state to be achieved but as an ongoing process of managing contradictions. Selviaridis and Spring (2018) demonstrated how supply chain alignment emerges through cycles of contracting and learning, where formal mechanisms generate unintended consequences requiring relational adjustments, which in turn create needs for new formal structures. This aligns with Lundin and Norrman's (2010) insight that alignment efforts often create new misalignments, suggesting a dialectical process where each solution contains the seeds of future problems.

Applying dialectical theory to the semiconductor crisis reveals how longstanding contradictions suddenly became acute. The automotive industry's just-in-time philosophy (thesis) had coexisted uncomfortably with the semiconductor industry's batch production model (antithesis) for decades, managed through Tier-1 suppliers who absorbed the tension. When the crisis eliminated this buffer, OEMs were forced to confront the contradiction directly. The resulting synthesis, direct OEM-semiconductor supplier relationships with information sharing but no volume commitments, represents a temporary resolution that itself generates new contradictions between transparency and flexibility.

The power of dialectical analysis lies in its recognition that supply chain relationships inherently contain contradictory yet interrelated elements that exist simultaneously and persist over time (Smith and Lewis, 2011). Rather than viewing misalignment as a problem to be solved, the dialectical perspective frames it as a generative force driving innovation and adaptation. This reframing has deep implications for how we understand and manage supply chain relationships, suggesting that success comes not from eliminating tensions but from developing capabilities to navigate them.

2.4.3. Collaboration

Beyond examining collaboration as an empirical foundation for alignment mechanisms, this thesis also adopts collaboration as an analytical lens to understand how alignment emerges, interacts, and develops in multi-tier supply chains. From this theoretical perspective, collaboration that spans the focal firm, its first-tier supplier, and the supplier's supplier transforms a triad from a linear structure into a jointly governed micro-network capable of coordinating objectives that dyad cannot reach. Multi-tier studies demonstrate that structured joint activities as: shared audits, pooled supplier-development programs, assessment-sharing alliances; increase transparency, redistribute monitoring costs, and amplify buyer leverage without compromising the Tier-1's integrative role (Grimm *et al.*, 2016; Lechler *et al.*, 2019; Najjar and Yasin, 2023). Such arrangements mitigate information asymmetry and agency risk, accelerate the diffusion of environmental practices upstream (Mena & Schoenherr, 2023), and strengthen network resilience by replacing unilateral enforcement with reciprocal problem-solving routines (Cao *et al.*, 2021; Statsenko *et al.*, 2025). Recent empirical work further shows that collaboration incentives must extend beyond focal–Tier-1 linkages: sub-supplier compliance improves only when Tier-1 suppliers are actively enlisted as co-developers and long-term partners, rather than passive gatekeepers (Grimm and Reinecke, 2024; Kähkönen *et al.*, 2023).

Applied to multi-tier supply chains, collaboration shows dynamics invisible through other lenses. It explains how triadic structures evolve from sequential chains into integrated networks. For example collaboration is crucial for circularity as direct buyer engagement with lower-tier suppliers enables early-stage design decisions that ease remanufacture and recycling, while joint data platforms and eco-intensity reporting schemes provide the traceability indispensable for reverse logistics (Tuni and Rentizelas, 2019). Cross-tier training, co-investment in take-back infrastructure, and industry-wide coalitions spread circular know-how beyond the first tier and reduce free-rider concerns that often stall reuse or repurpose initiatives (Braz and de Mello, 2024; Gong, *et al.*, 2023). Critically, these efforts succeed when collaboration is multi-directional, OEMs,

Tier-1s, lower tier suppliers co-develop standards and digital tools, so that circular objectives become institutionalized rather than episodic (Grimm *et al.*, 2023; Heldt and Beske-Janssen, 2023). Consequently, empirical evidence shows that triadic collaboration is a structural prerequisite for scaling circularity in complex supply networks.

2.5. Summary of theoretical framework

The summary theoretical framework of this thesis presented in Table 1 showing how the three appended papers are positioned across the core elements of this thesis framework. For each study it lists the theoretical perspective, context, core concepts and the specific literatures related to. This multi perspective approach enables a comprehensive understanding of how alignment mechanisms emerge, interact, and develop in the multi-tier management of automotive electronics supply chains.

By showing these details side by side, Table 1 makes clear how the papers work together. Paper I explains why misalignments arise and how transitional triads act as non-contractual alignment mechanisms. Paper II brings in a time dimension, revealing how contractual and relational mechanisms interact and develop in an OEM–Tier-1–Tier-2 chain. Paper III focuses to circularity, where cross-tier collaboration underpins reuse, remanufacturing, and repurpose. Together they cover structure, process, and collaboration, giving the thesis a coherent foundation for discussing alignment in multi-tier supply chain management.

Table 1: Theoretical positioning, contextual focus and relation to literature of the appended papers

	Paper I	**Paper II**	**Paper III**
Theoretical perspective	Agency theory	Dialectical process	Collaboration
Context	Resilience	Resilience	Circularity
Core concepts studied	Misalignments (4 levels: incentive, functional, operational, strategic) Transitional triads Agency problems	Alignment as process Dialectical tensions	Collaboration practices Circular practices (reuse, remanufacturing, repurpose)
Relations to multi-tier supply chain management literature	Transitional triads as structural change within multi-tier supply chains	Introduces dialectical lens to multi-tier supply chain management how governance oscillates over time	Extending multi-tier supply chain management by studying circularity across multiple tiers
Relation to supply chain Alignment literature	Demonstrates non-contractual alignment mechanisms of structural change	Conceptualizes alignment as dialectical process where Contractual and non-contractual alignment mechanisms interact and develop	Positions collaboration as foundation of alignment mechanisms

3. Research methods

This chapter presents the rationale for adopting a qualitative research approach and explicates the methodological choices underlying the three empirical studies that form the foundation of this dissertation. Further, it elaborates on the case selection, research process, data collection and analysis with description of the research process from start to till licentiate seminar. The chapter concludes with reflection of these decisions.

3.1. Research design

The adoption of a qualitative research approach for this thesis is grounded in an critical realist philosophical stance (Bhaskar, 2008; Easton, 2010), acknowledging that while an objective reality exists in the automotive electronics supply chain, our understanding of it is mediated through actors' interpretations and experiences. This philosophical position is particularly suited to studying complex supply chain phenomena where mechanisms operate at multiple levels, some observable, others hidden beneath surface events (Sayer, 2010). The critical realist approach allows to investigate both the structures of supply chain relationships and the agency of actors within them, making it ideal for understanding alignment and misalignment dynamics. This epistemological position recognizes that understanding complex phenomena requires deep engagement with the meanings, interpretations, and experiences of organizational actors (Bell *et al.*, 2022).

Qualitative research is particularly suited for this thesis for several reasons: The alignment phenomena under study are deeply embedded in contemporary supply chain contexts, requiring methods that preserve contextual richness rather than abstracting it away (Meredith, 1998). Quantitative approaches would struggle to capture the nuanced interplay of factors shaping firm processes and outcomes (Yin, 2018). Understanding how firm phenomena unfold over time requires methods sensitive to process, sequence, and emergence (Langley *et al.*, 2013). Qualitative approaches enable the capture of temporal dynamics that are often invisible in variance-based quantitative studies (Yin, 2018). The research aims to develop new theoretical insights rather than test existing theories. Qualitative methods are particularly suitable for theory building, enabling the discovery of unexpected relationships and the development of novel conceptual frameworks (Eisenhardt and Graebner, 2007). While quantitative methods excel at identifying correlations, qualitative approaches are better suited for uncovering causal mechanisms, the "how" and "why" behind observed relationships (Maxwell, 2012).

This thesis seeks to explain how alignment efforts emerge, interact and adapt over time between firms in multi-tier supply chains in the contexts of alignment for resilience and circularity. This “how”, “why” and “over-time” focus is characteristic of phenomena that are deeply embedded in context and poorly understood ex ante, precisely the conditions for which case study is recommended (Meredith, 1998; Yin, 2018). Finally, the qualitative approach enables what Weick (1995) calls "disciplined imagination", the ability to develop theoretical insights while maintaining empirical grounding. Therefore, qualitative approach is a suitable one for capturing the alignment mechanisms and their interplay for creating an in-depth understanding of interactions, processes and relationships.

In this thesis, case study method was adopted motivated by the nested phenomena in its empirical context and type of research questions. Case study research represents a

comprehensive research strategy rather than merely a data collection method (Yin, 2018). The choice of case study methodology for all three studies reflects several considerations specific to supply chain and firm research: Unlike statistical sampling aimed at population representation, case studies employ theoretical sampling to develop and refine theoretical insights. This approach enables the selection of cases that illuminate different aspects of the phenomenon, facilitating theory building through comparison and contrast (Eisenhardt and Graebner, 2007). Firms are complex systems characterized by multiple levels, interdependence, and emergent properties. Case studies preserve this complexity while enabling analytical focus, avoiding the oversimplification that can result from variable-based approaches (Anderson, 1999). Additionally, firm phenomena are deeply influenced by their contexts like institutional, cultural and temporal. Case studies enable the incorporation of multiple stakeholder perspectives, recognizing that organizational reality is multi-faceted and often contested (Johns, 2006). This multiplicity of viewpoints enriches understanding and reveals tensions and contradictions that drive firms' dynamics.

3.2. Methodological choices

Case study research is particularly suited for examining contemporary phenomena within their real-life contexts, especially when the boundaries between phenomenon and context are not clearly evident (Yin, 2018). Given the complexity of automotive electronics supply chains, case studies provide the depth and contextual richness necessary to understand the intricate relationships and processes at play. This dissertation employs both process-oriented case studies (Langley, 1999; Langley *et al.*, 2013) and multiple case studies (Eisenhardt, 2021; Eisenhardt and Graebner, 2007) to capture different dimensions of the phenomenon under investigation.

This thesis employs different case study designs across the three papers, each selected to match specific research objectives:

Paper I adopts a multiple case study design (Eisenhardt, 2021) examining two supply chain triads. This design enables cross-case comparison and pattern identification, strengthening the theoretical insights about misalignment mechanisms. The multiple case approach provides more robust and generalizable findings than single cases while maintaining depth of analysis (Eisenhardt and Graebner, 2007).

Paper II utilizes a longitudinal single case study design, following Pettigrew's (1990) processual approach and Langley's (1999) strategies for process research. This design captures temporal dynamics and allows for the observation of alignment as it develops over time, addressing calls for more process-oriented research in supply chain management (Grimm *et al.*, 2024). The longitudinal approach reveals patterns and mechanisms that cross-sectional studies might miss.

Paper III returns to a multiple case study design with embedded cases in multiple supply chains but focuses on different aspects, collaboration practices for circularity. This design allows for comparison across different circular initiatives while maintaining focus on the multi-tier dimension.

Table 2 presents a comprehensive comparison of the three studies, highlighting main methodological choices for Papers I, II, III in one place. It lists the type of case study,

number of cases, unit of analysis, time frame, reason for choosing each case, the specific supply-chain phenomenon examined, and the way each study was analyzed.

Table 2: Methodological design of appended papers

Dimension	Paper I	Paper II	Paper III
Case study type	Multiple case study (Eisenhardt, 2021)	Longitudinal single case study (Langley *et al.*, 2013; Pettigrew, 1990)	Multiple case study (Eisenhardt, 2021)
Number of cases	2 triadic cases (OEM-A network)	1 evolving triad	5 embedded circular-practice cases
Unit of Analysis	Supply-chain triad (OEM-Tier- 1-Tier -2)	Alignment process in triad over time	Collaboration practices for circularity between different tiers
Temporal dimension	Cross-sectional	Longitudinal (2020-2025)	Cross-sectional
Motivation for case selection	Defined by component flow and relationships	Defined by focal OEM and changing relationships	Defined by specific circular practices
Phenomenon studied	Misalignments-Alignment evolution	Alignment as dynamic process	Collaboration for circularity
Analysis approach	Within-case and cross-case analysis (Eisenhardt, 2021)	Process analysis using visual mapping (Langley, 1999)	Within-case and cross-case analysis (Eisenhardt, 2021)

3.3. Case selection

The case selection strategy for this thesis follows the principles of theoretical sampling (Eisenhardt, 2021), where cases are chosen for their potential to illuminate theoretical constructs rather than for statistical representativeness. This approach aligns with the thesis to build and elaborate theories about alignment mechanisms in multi-tier supply chains. Additionally, as Pettigrew (1990) emphasizes, purposeful sampling in process research requires selecting cases that provide opportunities to observe the phenomena of interest transparently. The overarching case selection was guided by three primary criteria. First, theoretical relevance where cases needed to exhibit instances of alignment and misalignment processes in multi-tiered supply chains. Second, cases should offer unique insights into previously unobserved or undertheorized phenomena to have revelatory potential. Lastly, cases must provide sufficient access to multiple tiers and levels of firms to enable deep investigation (Yin, 2018).

All three studies are embedded within the broader case context of the electronics supply chain serving the European automotive industry. This meta-case was selected for several compelling reasons, as empirical significance. The automotive electronics supply chain experienced disruption during the 2020-2023 semiconductor shortage, creating a natural experiment for studying alignment under stress. This crisis made previously hidden misalignments visible and showed explicit alignment efforts, providing rich

observational opportunities. Which leads to the next reason of theoretical richness, where automotive electronics supply chain context exhibits characteristics that make it theoretically interesting (e.g.: Multiple tiers with distinct operating logics: automotive vs. semiconductor industries; High technological complexity requiring coordination across supply chains; Strategic shifts towards vehicle electrification and circular economy). Finally, practical relevance of the context with electronics projected to constitute 45% of vehicle manufacturing costs by 2030 (Burkacky *et al.*, 2022), understanding alignment in this context has significant practical implications.

For Paper I, two triadic cases were selected within OEM-A's supply network. Both cases experienced shortages, making misalignment visible, two different Tier-1 and Tier-2 suppliers with recent structural changes in the supply network towards transitional triads. The selection followed a replication logic (Yin, 2018), seeking cases that would reveal similar patterns of misalignment during the semiconductor crisis. The selection of two cases balanced depth with comparative insights, following Eisenhardt's (2021) recommendation of 2-10 cases for theory building.

Paper II required a different selection approach, focusing on a single case that could be studied longitudinally. OEM-A's supply network evolution from 2020 till 2025 was selected with multiple Tier-1s and one Tier-2 based on the following rationale for single case selection: Unique access to real-time data during crisis and recovery periods; The semiconductor crisis created contractual and non-contractual alignment processes more explicit; Theoretical sampling over time while observing multiple alignment-misalignment cycles; Single case allowed for rich process data collection. This case selection follows Langley's (1999) guidance for process research, prioritizing temporal richness and access to unfolding events.

Paper III employed theoretical sampling to select cases of collaboration practices for circularity (Eisenhardt, 2021) across three dimensions: Supply chain tier involvement; Circularity stage (Design phase, use/after-sales, end-of-life); Circularity type (remanufacturing, reuse, repurpose). This was done in broader supply networks of OEM A and B including Tier-1 and Tier-2 suppliers, where five embedded cases in distinct supply chains were selected: Case 1, remanufacturing of defect electronics (OEM A and dealership network, spare-parts market); Case 2, repurposing of electronics (OEM-B, Tier-1 C, service providers, spare-parts market); Case 3, modular design (OEM-A, Tier-1 A, spare-parts market); Case 4, rebaking (OEM-A and Tier-1 B); Case 5 rebaking of obsolete inventory (OEM-A, Tier-2, Tier-1 [indirect]). This selection strategy ensured coverage of different tiers collaborations.

All cases exist within the broader automotive electronics supply network, sharing contextual factors like industry regulations, technology trajectories, and market dynamics. Several actors appear across multiple studies, as OEM-A is central to all studies, providing continuity. Where Tier-1s and Tier-2s appear into different extend in the three studies, in some cases allowing observation of both crisis response and circular initiatives. Finally, this comprehensive case selection strategy ensured that each study contributed unique insights while building toward the thesis's overall theoretical contribution about alignment in multi-tiered automotive electronics supply chains.

3.4. Research process

The research journey began in August 2023 with a practical puzzle: why did the semiconductor crisis (2020-2023) hit automotive OEMs so severely despite decades of sophisticated supply chain management? This section traces how this initial question developed into a systematic investigation of alignment mechanisms in multi-tier supply chains.

The first months were spent reviewing the literature to find relevant topics addressing the observed phenomena. Reviewed literature spanned from the field of operations and productions management to multi-tier supply chain management. In October 2023 parallel to reviewing literature, the first exploratory interviews were conducted with industry experts from the different tiers of the automotive electronics supply chain (OEMs, Tier-1s and Tier-2s). The review of literature and further interviews and observations were ongoing throughout the research in this thesis.

Early interviews in the end of 2023 with OEM procurement managers revealed a striking pattern: they repeatedly used phrases like "we thought our Tier-1s had it under control" and "suddenly we realized we weren't aligned with what was happening upstream." Similarly, Tier-1 suppliers described feeling "caught in the middle" between OEM demands and semiconductor supplier constraints as Tier-1 managers stated. These empirical observations directly pointed toward alignment, or rather misalignment, as the core phenomenon requiring investigation.

As interview data accumulated, three major insights emerged that shaped the theoretical direction in early 2024: Multi-tier complexity: Traditional dyadic alignment concepts failed to capture the three-way tensions between OEMs, Tier-1s, and semiconductor suppliers; Dynamic nature: Practitioners described alignment not as something achieved but as constantly "slipping away" whenever they tried to fix one relationship; Dual contexts: Interviewees independently raised how "alignment for crisis is different from alignment for sustainability" when discussing future circularity requirements

These empirical patterns led to focused literature reviews on supply chain alignment, multi-tier supply chain management, and agency theory, confirming that existing frameworks inadequately addressed the dynamic, multi-tier nature observed in practice. The empirical insights and theoretical gaps informed the design of three interrelated studies, as visualized in Figure 2:

Paper I (Data collection: November 2023 - March 2025) emerged from practitioners' descriptions of specific misalignments during the crisis. The cross-sectional design captured the immediate reality of misalignment types and initial responses, with agency theory providing the lens to understand the goal conflicts and information asymmetry practitioners described.

Paper II (Data collection: started before this research - ongoing) joined as co-author to another study, with access to the same supply chain data and ongoing research. This motivated my participation in the research and adopting insights from process research methods to capture these temporal dynamics of alignment mechanisms better.

Paper III (Data collection: November 2023 - ongoing) arose from a subset of interviews where managers spontaneously contrasted crisis responses with emerging circularity initiatives and circular practices that go beyond the crisis response.

As Figure 2 illustrates, the three studies developed in parallel with continuous improvements through conferences, reviews at conferences and discussions at the presentations. Further, the papers could inform each other better and new learnings could be integrated into the thesis. Paper I's finding that structural changes create new misalignments directly informed Paper II's focus on mechanism cycles. Paper II's processual insights shaped how collaboration was conceptualized in Paper III as an evolving mechanism rather than a static practice. This iterative approach allowed empirical discoveries in one study to refine theoretical development in others.

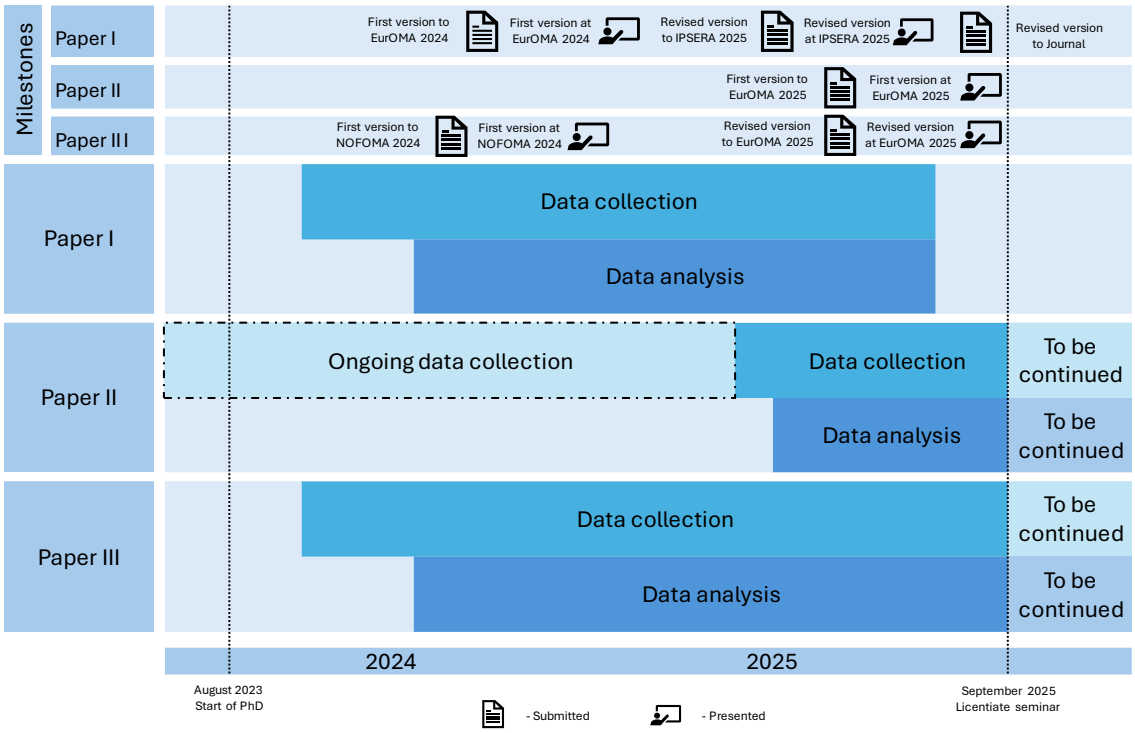

Figure 2: Timeline of the research process

In Paper I as the beginning of the research on alignment, the misalignments that caused the disruption in the semiconductor supply chains for the automobile industry were investigated exploratorily. Finding out what misalignments exist, how they appear, what attempts are made to align, and how the misalignments alter as the supply chain was the goal of this work. In order to accomplish this goal, the study was designed as exploratory qualitative research, and agency theory was used to supplement the qualitative analysis to examine the features of misalignments and alignment attempts.

Following early findings from Paper I on the cyclical nature of the alignment and different mechanisms. The author joined the second study in the middle of data collection as part of the investigation on alignment from a processual perspective, as this study started before the work on this thesis. In Paper II, the author contributed to part of the data collection and analysis, part of the interpretation of the results, and part of the writing of the methods and findings sections. Following this thesis, the longitudinal research will

continue for an additional one to two years. Early findings on the processual nature of the alignment and interplay of different mechanisms complement the first study.

Paper III was an exploratory study on circularity as it was determined to be a relevant topic at the start of the research. Investigating alignment from a different perspective than governance mechanisms as a result of collaboration was the aim of this study. Once again a qualitative study design was adopted with embedded cases in the supply chains.

The three studies were developed in parallel, and insights generated in one continuously informed the design and interpretation of the other. This iterative dialogue sharpened the overall research focus and strengthened the conceptual ties between the papers. What the author observed in Paper I, prompted more targeted questioning and richer observation in Paper II. This process was interactive including Paper III. In that setting, the author could examine better how the actors in the supply chain confronted similar challenges through the different mechanisms.

3.5. Data collection

The data collection strategy was designed to capture both the structural characteristics of the supply chain and the dynamic processes of alignment and misalignment. Given the structural change and resulting multi-tier management nature of the automotive electronics supply chain and the processual character of alignment. The data collection involved multiple actors across different tiers and extended over a period from November 2023 to Spring 2025. Following the principles of theoretical sampling (Eisenhardt, 2021), data sources were selected based on their potential to illuminate the alignment phenomena across multiple tiers. The strategy involved three main components: (1) semi-structured interviews with key informants across the supply chain tiers, (2) direct observations through site visits and workshops, and (3) collection of secondary data including company documents, reports, and presentations. To ensure data quality and minimize recall bias, particularly important given the retrospective elements in Paper II, the data collection followed a triangulation approach (Yin, 2018). Multiple data sources were used to verify findings, and when possible, multiple informants from the same organization were interviewed to capture different perspectives on the same phenomena.

The semi-structured interviews followed established protocols tailored to each study's research questions while maintaining flexibility to explore emergent themes (Yin, 2018). Semi-structured interviews formed the primary data collection method across all three papers, following established guidelines for qualitative research in supply chain management (Ketokivi and Choi, 2014). Interview guides were developed for each paper with overlapping sections to capture both alignment-related and circularity-related insights from the same informants where relevant. All interviews were conducted either in person or via video conferencing, recorded with participants' consent, and transcribed verbatim. When recording was not permitted (5 instances), detailed notes were taken during and immediately after the interviews.

The selection of interviewees followed a purposive sampling strategy (Patton, 2015), targeting individuals with direct involvement in semiconductor procurement, supply chain management, or circular economy initiatives. Initial contacts were established through the OEM's procurement department, with subsequent interviewees identified through snowball sampling.

Additionally, complementary data collection methods as company workshops provided opportunities for group discussions and validation of emerging findings. These sessions typically lasted 2 hours and included 5-8 participants from different functional areas within the same organization. The workshops served dual purposes: gathering additional data and validating preliminary findings through member checking. Site visits enabled direct observation of operational processes and provided contextual understanding of the supply chain practices discussed in interviews. These visits typically lasted 3-8 hours and included facility tours, informal conversations with operational staff, and observation of daily activities.

As shown in Table 3, several interviews contributed to multiple papers. In these cases, the interview protocols were designed with distinct sections addressing different research questions. For instance, Interview 20 with the Tier-2 A supply chain specialist included two distinct segments: the first 60 minutes focused on misalignments during the semiconductor crisis, and the final 30 minutes explored circular practices.

Table 3: Overview of data sources

Paper	Company	Sources
Paper I	OEM A	8 interviews – Procurement, R&D, Risk management; 2 company workshops
	Tier-1 A	5 interviews – Supply chain management; 1 site visit; 1 company workshop
	Tier-1 B	1 interview – Supply chain management; 1 company workshop
	Tier-2 A	5 interviews – Supply chain management, Key account management Tier-1, Strategy; 1 site visit
Paper II	OEM A	9 interviews – Procurement, R&D, Risk management; 2 company workshops
	Tier-1 A	5 interviews – Supply chain management; 1 site visit; 1 company workshop
	Tier-1 B	1 interview – Supply chain management; 1 company workshop
	Tier-1 C	1 interview – Procurement, R&D;
	Tier-2 A	6 interviews – Supply chain management, Key account management Tier-1 and Tier-2, Strategy; 1 site visit
Paper III	OEM A	3 interviews – Procurement; 2 company workshops
	OEM B	2 interviews – Sustainability; R&D
	Tier-1 A	6 interviews – Supply chain management; Sustainability 1 site visit; 1 company workshop
	Tier-1 C	1 interview – Procurement, R&D;
	Tier-2 A	4 interviews – Supply chain management, Key account management, Strategy;

Across the entire research process 24 semi-structured interviews, 4 site visits and 3 workshops were conducted. Whereas 18 interviews, all four site visits and all three workshops, informed Paper I; 22 interviews, three four visits and all three workshops

informed Paper II; and 16 interviews, all four visit and a single workshop informed Paper III. Importantly, data sources were not mutually exclusive whereas:

- Interviews with OEM A: 3 of them were used in all three papers, 8 in paper I and II and one interview for in Paper II
- Interviews with OEM B: 2 interviews used for Paper III
- Interview with Tier-1 A: 5 of them were used in all three papers and 1 of them only in Paper II
- Interviews with Tier-1 B: 1 interview used for Paper I and II
- Interviews with Tier-1 C: 1 interview used for Paper I and II
- Interviews with Tier-2 A: 4 of them were used in all three papers, 5 in paper I and II and one interview for in Paper II

Finally, re-using the same interviews across studies strengthens construct validity through triangulation of multiple data sources (Yin, 2018) and deepens theoretical saturation, yet it risks selective bias and data-thinning. Following research quality guidelines, the different studies: (i) triangulated every reused quotation with at least one study-specific source (site notes or workshop minutes), (ii) re-coded transcripts de-novo for each paper rather than porting prior codebooks, (iii) kept chain of evidence linking codes to raw data, and (iv) conducted interviewees checking sessions e.g.: at OEM A and Tier-2 A in Spring 2025. Such safeguards were used to ensure evidence from multiple sources for the same studies.

3.6. Data analysis

The data analysis followed established qualitative research protocols, combining within-case and cross-case analysis techniques (Eisenhardt, 2021; Eisenhardt and Graebner, 2007) with process-oriented analytical strategies (Langley *et al.*, 2013). The analysis approach varied across the three papers to match their specific research objectives while maintaining methodological rigor throughout.

The overarching analytical strategy combined deductive and inductive approaches, consistent with the abductive reasoning inherent in case study research (Dubois and Gadde, 2002). This iterative approach allowed for continuous movement between empirical observations and theoretical concepts, enabling both theory elaboration and emergent insight development (Ketokivi and Choi, 2014). All interview transcripts, field notes, and documents underwent multiple rounds of coding using established qualitative data analysis procedures (Miles *et al.*, 2014).

Paper I and Paper III

Papers I and III employed similar analytical approaches, following Eisenhardt's (2021) methodology for building theory from multiple cases. The analysis proceeded through distinct phases described below.

Each case was first analyzed independently through within-case analysis (Eisenhardt, 2021) to develop rich case descriptions and identify patterns within individual triads (Paper I) or circular practices (Paper III). This involved constructing detailed case narratives that traced the sequence of events, decisions, and outcomes. For Paper I, this meant mapping how misalignments manifested and developed within each OEM –Tier-1

–Tier-2 triad. For Paper III, it involved documenting how each circular practice emerged and operated within its specific supply chain configuration.

Following individual case analysis, cross-case analysis was carried out (Eisenhardt, 2021). Therefore, systematic comparison across cases was conducted using replication logic (Yin, 2018). This involved creating meta-matrices to compare cases along theoretical dimensions (Miles *et al.*, 2014). In Paper I, cases were compared across the four misalignment levels and agency theory constructs. Paper III compared cases along three dimensions: supply chain tier involvement, circularity stage, and circularity type. This structured comparison enabled identification of patterns and relationships that held across cases versus those that were case-specific (Eisenhardt and Graebner, 2007).

The cross-case synthesis followed Eisenhardt's (2021) tactics for searching for cross-case patterns, including: selecting categories and looking for within-group similarities coupled with intergroup differences; selecting pairs of cases and listing similarities and differences; and dividing data by source to exploit unique insights possible from different data collection methods.

Paper II

Paper II required a different analytical approach to capture temporal dynamics and processual patterns. The analysis drew extensively on Langley's (1999) strategies for theorizing from process data and incorporated temporal bracketing techniques (Langley *et al.*, 2013).

Temporal bracketing: The 2020-2025 period was divided into distinct phases based on key events and turning points in the alignment process. This decomposition enabled comparative analysis of how alignment mechanisms operated differently across temporal periods (Langley, 1999). The brackets were not predetermined but emerged through iterative analysis of when qualitative changes occurred in nature or intensity of alignment efforts.

Visual mapping: Following Langley's (1999) visual mapping strategy, the analysis constructed graphical representations of the alignment process (as shown in Paper II's Figure 2). This technique helped identify temporal patterns, feedback loops, and the sequencing of contractual and non-contractual mechanisms. Visual mapping made complex temporal relationships more transparent and facilitated pattern recognition across the extended time period.

Dialectical analysis: The identification of thesis-antithesis-synthesis patterns required specific analytical attention to contradictions and their resolutions. Drawing on Van de Ven and Poole's (1995) dialectical model, the analysis systematically searched for opposing forces, the tensions they created, and the synthetic resolutions that emerged. This involved coding for conflict episodes, identifying the underlying contradictions, and tracing how compromises were negotiated and implemented.

Integration

Throughout all analyses, several techniques ensured analytical rigor. Investigator triangulation occurred through regular research team meetings where emerging interpretations were challenged and refined (Eisenhardt, 2021). Pattern matching logic

was employed to compare empirically observed patterns with theoretically predicted ones (Yin, 2018). In addition, follow-up interviews and during company workshops with professionals were carried out to verify the factual accuracy and practical resonance of emerging insights. For disconfirming evidence, the analysis actively searched for data that contradicted emerging theoretical insights, following Eisenhardt's (2021) recommendation to sharpen theory building.

The analytical process was iterative rather than linear, with findings from later stages prompting reexamination of earlier coding and interpretations. This recursive approach, characteristic of high-quality qualitative research (Miles *et al.*, 2014), continued until theoretical saturation was reached - when additional analysis yielded minimal new insights and the theoretical relationships were well-specified.

This comprehensive analytical approach enabled deep understanding of alignment mechanisms while maintaining the flexibility to capture emergent phenomena, ultimately supporting robust answers to the research questions of the corresponding Papers.

3.7. Reflection on methodological approach

The decision to adopt a qualitative case study approach across all three papers warrants critical reflection. Case study research has been both celebrated and criticized within operations and supply chain management research (Ketokivi and Choi, 2014). The strength of this approach lies in its ability to capture the complexity and contextuality of supply chain phenomena, particularly important when studying emergent and processual aspects of alignment (Dubois and Gadde, 2002).

The case study method proved particularly valuable for several reasons. First, it enabled the investigation of alignment as it naturally occurs within its organizational and inter-organizational context, preserving the richness that would be lost through abstraction (Voss, 2008). Second, the method's flexibility allowed for iterative movement between theory and empirical observations, facilitating the development of novel theoretical insights about transitional triads and alignment mechanisms (Eisenhardt and Graebner, 2007).

However, this methodological choice also presents limitations. The focus in Paper I and II on a single supply network (OEM A and its suppliers) raises questions about the generalizability of findings (Yin, 2018). While theoretical generalization rather than statistical generalization was the aim, the specific characteristics of the automotive electronics context, including high technical complexity, stringent quality requirements, and the impact of the semiconductor crisis, may limit the transferability of insights to other industries or supply chain contexts. To address these limitations, multiple strategies were employed. The inclusion of multiple suppliers and multiple triadic configurations provided some degree of replication logic (Yin, 2018). Additionally, the findings were regularly discussed with practitioners from other automotive companies and industries, providing some validation of their broader applicability.

The decision to adopt a multi-tier perspective, moving beyond traditional dyadic buyer-supplier relationships, presented both opportunities and challenges. The multi-tier lens proved essential for understanding how misalignments cascade through supply chains and how alignment mechanisms must account for indirect relationships. However,

accessing multiple tiers presented significant methodological challenges. As noted by Grimm et al. (2024), researchers often face difficulties in gaining access to lower-tier suppliers due to confidentiality concerns and lack of direct relationships. In this research, access was facilitated through OEM A's relationships, which potentially introduced a focal-firm bias in the data collection. Tier-2 suppliers might have been reluctant to share information that could reflect negatively on their relationships with Tier-1 suppliers or the OEM.

To mitigate this bias, several strategies were employed. First, interviews with Tier-2 suppliers were conducted independently, with assurances of confidentiality. Second, data from multiple sources were triangulated to identify potential biases or inconsistencies. Third, industry experts and distributors provided external perspectives that helped validate or challenge the views expressed by supply chain members.

The adoption of a processual lens, particularly in Paper II, reflects the recognition that alignment is not a static state but an ongoing accomplishment (Langley, 1999; Selviaridis and Spring, 2018). This perspective enabled the identification of temporal dynamics, feedback loops, and the cyclical nature of alignment efforts that would be invisible in cross-sectional studies.

Furthermore, the processual analysis required making analytical choices about temporal bracketing and identifying key events (Langley, 1999). These choices inevitably involve researchers' interpretation and could influence the findings. To address this, the temporal brackets and key events were validated through member checking with long-tenured employees who had experienced the full period under study.

This thesis ensures research quality by following the criteria established by Lincoln and Guba (1985) for evaluating qualitative research, this thesis addressed four key dimensions of trustworthiness:

Credibility was pursued through multiple strategies. Prolonged engagement with the research context, spanning 2 years, enabled deep familiarity with the phenomena under study (Lincoln and Guba, 1985). Triangulation across data sources (interviews, observations, documents), methods (qualitative analysis supplemented by network metrics), and investigators (through co-authorship and research team discussions) strengthened the credibility of findings. Member checking, where preliminary findings were shared with key informants for validation, provided additional credibility assurance (Creswell and Miller, 2000).

Transferability was addressed through thick description of the research context, enabling readers to assess the applicability of findings to other settings (Lincoln and Guba, 1985). Detailed descriptions of the automotive electronics supply chain, the semiconductor crisis context, and the specific characteristics of the studied organizations provide the necessary context for transferability judgments.

Dependability was ensured through systematic documentation of research procedures, creating an audit trail that allows others to understand and potentially replicate the research process (Bowen, 2009). The use of case study protocols, interview guides, and coding schemes, along with their iterative refinement, contributed to dependability.

Confirmability was pursued through reflexive practices acknowledging the researchers' positions and potential biases (Alvesson and Sköldberg, 2018). Regular peer debriefing sessions within the research team and with academic colleagues provided external checks on interpretations. The search for disconfirming evidence and alternative explanations helped guard against confirmation bias.

Finally, the sensitive nature of supply chain relationships, particularly during the crisis period, required careful handling of confidential information. All company and individual identities were anonymized in the research outputs, and specific technical or commercial details that could compromise competitive positions were excluded or generalized (Wiles *et al.*, 2008).

Several methodological limitations merit acknowledgment. First, the Western European context of the study may limit the applicability of findings to other geographical regions with different institutional environments or business cultures (Hofstede, 2013). Second, the focus on a crisis period (semiconductor shortage) may have heightened the salience of certain alignment mechanisms that might be less prominent during stable periods. Third, the predominant reliance on interview data, despite triangulation efforts, means that findings are filtered through participants' perceptions and interpretations.

These limitations were addressed through several strategies. The inclusion of Asian semiconductor suppliers and global market perspectives provided some geographical diversity. The longitudinal perspective in Paper II captured both crisis and stable periods, allowing for comparison. The combination of multiple data sources and the validation of findings through different mechanisms helped ensure that the research captured not just perceptions but also observable patterns and outcomes.

In conclusion, while the methodological approach adopted in this thesis has limitations inherent to qualitative case study research, careful attention to quality criteria, and the systematic use of multiple strategies to address potential weaknesses provides confidence in the robustness of the findings. The rich insights generated about alignment mechanisms in multi-tier supply chains justify the methodological choices while acknowledging their boundaries.

4. Summary of papers

This chapter presents the three empirical studies that form the foundation of this thesis and collectively address how alignment mechanisms emerge, interact, and develop in multi-tier automotive electronics supply chains. The chapter synthesizes the findings from each paper. The three papers adopt complementary approaches to investigate alignment in multi-tier supply chains as summarized in Table 4.

Paper I establishes the empirical foundation by mapping misalignments across OEM–Tier-1–Tier-2 triads during the semiconductor crisis of 2020-2023. Using agency theory as an analytical lens, the paper develops a comprehensive typology of misalignments and documents the initial alignment mechanisms employed as firms transition from open to transitional triadic structures. The key insight that alignment efforts create cyclical patterns rather than stable solutions directly informs the subsequent studies.

Paper II builds on this cyclical understanding by adopting a longitudinal process perspective to trace how alignment mechanisms develop from 2020 to 2025. The study reveals the dialectical interplay between contractual and relational mechanisms, showing how formal controls trigger relational responses and vice versa. This processual analysis deepens our understanding of why the structural changes identified in Paper I create new misalignments while resolving others.

Paper III extends the investigation to examine how collaboration as foundation of alignment mechanisms enable alignment for strategic objectives, specifically the transition to circular economy practices. While Papers I and II focus on reactive alignment triggered by supply disruptions, Paper III explores proactive alignment for circularity transformation.

Table 4: Summary of papers

Paper	Title	Method	Purpose	Theoretical lens	Contributing
I	*Misalignments in multi-tier supply chain: An Agency Theory perspective*	Multiple case study	Investigate how supply chain misalignments develop as supply chains form transitional triads.	Agency theory as an analytical lens and multi-tier theory for triadic arrangements	Mainly RQ1 Partly RQ2
II	*The bumpy road to supply chain alignment: Evidence from the European car industry*	Longitudinal case study	Study how multiple alignment mechanisms develop and interact to enable or constrain supply chain alignment, in response to important changes in the business environment or disruptive events.	Dialectical process and supply chain alignment as process	Mainly RQ2 Partly RQ1
III	*A multi-tier perspective on circularity: Insights from the semiconductor supply chain to automotive*	Multiple case study	Explore the collaboration practices of circularity in multi-tiered supply chain of electronics to the automotive. Specifically, which forms of collaboration for circularity, and under what conditions are present in a technologically sophisticated setting.	Multi-tier supply chain management literature with collaboration	Partly RQ1 and RQ2

Each paper employs distinct theoretical lenses and methodological approaches suited to its research objectives. Paper I utilize agency theory to analyze principal-agent problems in multi-tier relationships, employing a multiple case study design with cross-

sectional data collection. Paper II draws on dialectical process, using a longitudinal single case study to capture temporal dynamics. Paper III integrates multi-tier supply chain management literature with collaboration, adopting a multiple case design to examine collaboration practices across different circularity initiatives.

This methodological diversity strengthens the thesis by providing both breadth (multiple cases in Papers I and III) and depth (longitudinal analysis in Paper II), while theoretical pluralism enables examination of alignment from structural, processual, and collaboration perspectives. The consistent focus on automotive electronics supply chains ensures empirical coherence while allowing each study to illuminate different facets of the alignment phenomenon.

4.1. Paper I *"Misalignments in multi-tier supply chain: An Agency Theory perspective"*

Paper I establishes the empirical foundation for understanding how misalignments manifest in multi-tier supply chains and what alignment mechanisms emerge in response. The study investigates how supply chain misalignments develop as automotive electronics supply chains form transitional triads, particularly during the semiconductor crisis of 2020-2023. Through a multiple case study design examining two OEM –Tier-1 –Tier-2 triads, the research employs agency theory as an analytical lens to understand the principal-agent problems that arise when OEMs attempt to manage relationships beyond their direct suppliers.

The paper's primary contribution to RQ1 lies in its comprehensive characterization of misalignments across four levels: incentive, functional, operational, and strategic. At the incentive level, misalignments arise from conflicting contractual arrangements, where OEMs maintain flexible contracts without volume commitments while Tier-2 suppliers require long-term commitments for capacity planning. This creates a tension where Tier-1 suppliers must absorb the risk of demand uncertainty, leading to opportunistic behaviors and suboptimal inventory decisions. Functional misalignments manifest through poor internal collaboration and communication between procurement and R&D teams, resulting in fragmented decision-making about semiconductor selection and sourcing strategies. Operational misalignments emerge from incompatible business logics, particularly the clash between automotive just-in-time systems requiring daily flexibility and semiconductor batch production with long lead times. Strategic misalignments appear as knowledge gaps where OEMs lack understanding of semiconductor technology and end-of-life risks, combined with conflicting inventory strategies where no tier wants to hold buffer stock despite recognizing system-wide vulnerabilities.

The findings reveal that these misalignments trigger specific alignment mechanisms, most notably the structural change from open to transitional triads. In open triads, OEMs relied entirely on Tier-1 suppliers to manage upstream relationships, creating information asymmetries and coordination failures. The crisis prompted OEMs to establish direct but informal links with Tier-2 semiconductor suppliers, forming transitional triads that enable information sharing while maintaining Tier-1's operational role. These structural changes are supported by various mechanisms: three-party meetings where OEMs, Tier-1s, and Tier-2s jointly discuss capacity and allocation; direct program file exchanges between OEMs and Tier-2s to improve demand visibility; creation of dedicated semiconductor

procurement teams and key account manager roles; and OEM audits at Tier-1 facilities to verify allocation decisions. However, the research demonstrates that while these mechanisms address immediate coordination problems, they do not eliminate underlying misalignments.

Most significantly for the thesis, Paper I establishes that alignment is not a stable state but rather a perpetual cycle expressed mathematically as $A(t+1) = \min\{1, A(t)-x+C\}$, where alignment efforts (C) address some misalignments (x) but simultaneously create new ones. For instance, when OEMs establish direct links to Tier-2 suppliers to improve information transparency, this undermines Tier-1's coordinating role and creates new tensions about responsibility boundaries. The paper introduces the concept of a "dual-agent shadow," whereby Tier-1 suppliers lose their information monopoly and bargaining power when OEMs establish direct Tier-2 links yet retain operational responsibilities for component integration and quality. This creates a paradox where Tier-1s have reduced control but unchanged accountability, generating new incentive misalignments even as information asymmetries decrease. This cyclical insight reframes alignment from a problem to be solved to an ongoing process to be managed, directly motivating the processual investigation in Paper II.

4.2. Paper II *"The bumpy road to supply chain alignment: Evidence from the European car industry"*

Building on Paper I's insight about the cyclical nature of alignment, Paper II adopts a processual perspective to examine how alignment mechanisms develop and interact over time in automotive electronics supply chains. The study directly addresses RQ2 by tracing the temporal dynamics of contractual and relational alignment mechanisms from 2020 to 2025, encompassing both the acute crisis period and its aftermath. Through a longitudinal single case study design, the research follows one automotive OEM and its evolving relationships with multiple Tier-1 suppliers and a Tier-2 semiconductor manufacturer.

The paper reveals that alignment mechanisms operate through a dialectical process characterized by three main episodes of thesis-antithesis-synthesis. In the first episode, the thesis of OEMs' just-in-time production philosophy, requiring short-term flexibility and minimal inventory, conflicts with the antithesis of semiconductor suppliers' batch production requiring 3-6 month planning horizons and stable demand. This contradiction intensifies during the crisis when OEMs' demand volatility prevents Tier-2s from securing upstream capacity. The synthesis emerges through collaboration enabling practices including the creation of Key Account Manager roles, formalized information sharing protocols, and joint planning sessions, though these only partially reconcile the underlying tension. The second episode centers on contractual flexibility, where OEMs' insistence on maintaining flexible contracts without volume commitments clashes with semiconductor industry norms requiring firm orders to allocate capacity. This drives the establishment of direct OEM–Tier-2 communication channels, initially informal but increasingly formalized through strategic business agreements, though notably these agreements still avoid volume commitments. The third episode involves inventory management, where all parties' preference for lean operations conflicts with the need for buffer stock to ensure supply security, leading to negotiated compromises where OEMs mandate higher inventory levels at Tier-1s despite resistance.

The temporal analysis demonstrates complex interaction patterns between contractual and relational alignment mechanisms. When OEMs impose new contractual requirements, such as mandatory buffer levels or enhanced reporting obligations, this triggers a period of relational strain requiring extensive trust-building efforts through increased communication, joint problem-solving workshops, and senior management engagement. Conversely, periods of strong relational alignment, characterized by open information sharing and collaborative innovation, create conditions for new contractual arrangements, such as the formalization of OEM–Tier-2 relationships that began as crisis-driven informal contacts. However, these mechanisms do not simply alternate in regular cycles; instead, they exhibit recursive patterns where each intervention generates unintended consequences requiring further adjustments. For example, direct OEM–Tier-2 agreements improve information flow but create role ambiguity for Tier-1s, who must then renegotiate their value proposition from pure intermediation to technical integration and risk management.

Particularly revealing is the finding that as the immediate crisis subsides, many pre-crisis practices resurface despite their acknowledged limitations. OEMs return to flexible contracting practices even after experiencing how this hindered semiconductor allocation during shortages. Tier-1 suppliers resume minimal inventory strategies despite having witnessed the cascading effects of supply disruptions. Tier-2 suppliers maintain their allocation rules favoring large-volume customers. This persistence of established practices demonstrates how deeply embedded business logic constrains alignment efforts, suggesting that even severe disruptions may not alter entrenched operational paradigms. The processual understanding reveals that alignment in multi-tier supply chains involves continuous oscillation between states of greater and lesser alignment, driven by the dialectical interplay of competing logics that can be managed but not eliminated. This finding bridges Paper I's identification of alignment as cyclical.

4.3. Paper III *"A multi-tier perspective on circularity: Insights from the semiconductor supply chain to automotive"*

Paper III extends the alignment discussion beyond resilience to examine how collaboration as foundation of alignment mechanisms through multiple tiers enables alignment for strategic transitions, specifically circularity. Addressing RQ1 and RQ2, the study investigates which forms of multi-tier collaboration emerge for circular practices and under what conditions they succeed in the technologically complex automotive electronics supply chain. Through a multiple case study design examining five distinct collaboration practices for circularity being process of alignment mechanisms.

The findings identify five distinct collaboration cases for circularity, each involving different actor configurations and resource-sharing arrangements. Case 1 demonstrates OEM-dealership collaboration for remanufacturing defect electronics, where alignment occurs through internal logistics networks and established warranty processes, requiring minimal upstream involvement but significant manual labor. Case 2 reveals OEM –Tier-1 service collaboration for repurposing "no fault found" electronics, leveraging suppliers' existing testing infrastructure to redirect functional components to secondary markets rather than scrapping them. Case 3 presents supplier-led innovation where a Tier-1 proactively develops modular printed circuit boards enabling component reuse, with OEM involvement limited to co-development feedback and performance validation. Case

4 shows operational flexibility through joint "rebaking" processes where obsolete electronics are retested and updated, with resources deployed either at OEM facilities or through mobile Tier-1 teams. Case 5 illustrates crisis-driven innovation where direct OEM –Tier-2 collaboration enables requalification of obsolete semiconductor inventory, bypassing traditional Tier-1 intermediation. These cases reveal that circular practices emerge through diverse pathways rather than following a single model of OEM-led sustainability initiatives.

The conditions enabling successful collaboration for circularity differ markedly from those driving alignment for resilience examined in Papers I and II. While crisis response relies on rapid information sharing and emergency coordination, circular practices require longer-term resource commitments and capability development. Success depends on which actor controls essential resources: testing facilities for verification, design capabilities for modularity, storage infrastructure for inventory management, or market access for secondary sales. The research reveals that immediate economic incentives often prove more powerful than sustainability goals in driving collaboration. For instance, semiconductor shortages motivated companies to explore rebaking and requalification not for environmental benefits but to access otherwise unavailable components. This pragmatic origin, however, creates infrastructure and routines that can be leveraged for systematic circular practices. The temporal dimension also matters significantly, design-phase interventions like modularity require extensive upfront coordination but enable multiple circular pathways, while end-of-life interventions can be implemented quickly but offer limited value recovery. Notably, successful collaborations often begin with bilateral arrangements that gradually expand to include additional actors as practices mature and demonstrate value.

Most significantly for understanding multi-tier alignment, the study demonstrates that effective circularity goes beyond traditional supply chain hierarchies and wider supply network thinking. Unlike the vertical alignment mechanisms documented in Papers I and II, circular practices often involve horizontal collaboration with service providers, recyclers, and secondary market actors. The OEM's role shifts from directing suppliers to orchestrating networks, while Tier-1 suppliers can become innovation leaders rather than mere intermediaries. This reconceptualization reveals how alignment mechanisms initially developed for crisis response can be repurposed for strategic transformation. The direct OEM–Tier-2 relationships established during semiconductor shortages create communication channels that enable collaborative circular innovation. The operational capabilities developed for managing shortages, such as component tracking and quality verification systems, support circular practices like repurposing. However, the study also identifies persistent barriers: regulatory constraints on component reuse in safety-critical applications, intellectual property concerns limiting design information sharing, and cost structures favoring new component production over circular alternatives. These findings contribute to understanding how multi-tier alignment for strategic objectives requires not just bilateral coordination but supply network wide collaboration.

5. Findings and Discussion

The purpose of this thesis is to contribute to the supply chain alignment literature by explaining how alignment mechanisms emerge, interact, and develop in multi-tier supply chain management, using the empirical contexts of resilience and circularity in automotive electronics supply chain as settings for understanding these dynamic processes. Through three studies, this research has generated insights that advance our understanding in managing alignment in multi-tier supply chains. This section synthesizes the findings across the three papers in relation to alignment mechanisms and dynamics as summarized in Table 5 and discussed below.

Table 5: Synthesis of papers on alignment mechanisms and dynamics

Dimension	Paper I	Paper II	Paper III	Cross-paper synthesis	Implications for theory	Context specific insights
Alignment mechanism types	Transitional triads as non-contractual alignment mechanisms	Oscillating between contractual and non-contractual alignment mechanisms	Collaboration as foundational enabler	Alignment mechanisms operate on different levels: structural change triggers dialectical responses, all made possible by collaboration	Alignment requires different interacting mechanisms not a single fix; interactions are recursive, not linear	Resilience, requires rapid adaptations; Circularity requires patient collaborative building
Dynamics	Cyclical alignment, transitional triads solve some misalignments while generating new ones.	Dialectical episodes with unstable synthesis	Crisis mechanisms mature into strategic capabilities	Short-term fixes become long-term constraints; each action creates path-dependencies	Challenges equilibrium models: alignment is perpetual oscillation, not one path to stability	Resilience cycles in days/weeks Circularity matures over years
Unintended consequences	Transitional triads fix some misalignments but create new ones	Crisis management systems become ineffective in stability.	"Accidental circularity" driven by cost, not sustainability	Mechanisms optimized for one context become constraints in another; emergency fixes become institutionalized	Alignment has cascading, supply network wide effects	Resilience fixes can be inefficient in normal settings Crisis adaptations can spark new circular practices

Multi-tier alignment mechanisms

The alignment mechanisms identified across the three papers operate not as isolated interventions but as interconnected levels within a complex governance structure. Transitional triads (Paper I) represent structural change that alter supply network configurations by establishing direct OEM–Tier-2 links, bypassing Tier-1 supplier. However, these structural changes do not function in isolation; they trigger the dialectical responses documented in Paper II, where contractual formalization generates relational compensation, which in turn necessitates further formalization in an oscillation. This recursive pattern critically depends on the collaborative foundation revealed in Paper III, without underlying trust-building, information sharing etc., neither structural adaptations nor dialectical evolution can sustain themselves.

The semiconductor taskforce exemplifies this multi-level interaction. Its creation as a non-contractual alignment mechanism (in transitional triad) generated dialectical tensions between automotive just-in-time logic and semiconductor batch production requirements. These tensions could only be managed through collaboration practices like joint meetings and discussions leading about supply assurance, which themselves required trust built

through repeated crisis interactions. This finding extends governance literature complementarity view by demonstrating that mechanisms actively reshape each other through feedback loops. When OEMs established direct Tier-2 relationships, this structural change didn't simply add a communication channel but altered how existing Tier-1 relationships functioned, forcing suppliers to redefine their role and information monopoly.

The collaboration as foundation identified in Paper III proves essential yet paradoxical. While collaboration enables both structural changes and dialectical evolution, it simultaneously undermines traditional hierarchies of the supply chain governance. Successful circular practices like modular PCB design require Tier-1 suppliers to lead innovation while OEMs provide logistics infrastructure, a reversal of traditional innovation hierarchies that agency theory cannot adequately explain. This suggests alignment mechanisms in multi-tier contexts must manage not just operational coordination but continuous renegotiation of roles, responsibilities, and value distribution across supply network.

Dynamics of alignment mechanisms

The developments of alignment mechanisms dynamics reveal a pattern more complex than linear progression or simple cycles. The mathematical formulation $A(t+1) = \min\{1, A(t)-x+C\}$ from Paper I captures the mechanical aspect of alignment dynamics, but Papers II and III reveal the deeper temporal complexities. Short-term crisis interventions create long-term structural implications.

The dialectical episodes in Paper II demonstrate how each thesis-antithesis-synthesis cycle creates temporary stability that immediately generates new contradictions. The first episode's synthesis, collaborative planning between OEMs and Tier-2s, resolved immediate allocation conflicts but created new tensions around forecast accuracy and risk distribution. These new tensions triggered the second dialectical episode, where increased transparency conflicted with commercial confidentiality, leading to selective information sharing protocols that satisfied neither party fully. This pattern reveals alignment not as path towards equilibrium but as perpetual oscillation between different logics.

From decisions as those during crisis responses new path dependencies emerge. The semiconductor procurement teams, Key Account Manager roles, and strategic business agreements created during 2020-2023 now constitute permanent organizational features despite being optimized for shortage management rather than normal operations. Paper II's longitudinal analysis reveals how these structures persist even when crisis conditions subside, as they create vested interests, specialized competencies, and inter-organizational routines that become self-reinforcing. The dual temporality identified, resilience mechanisms operating in day/week cycles while circularity requires year-long maturation, means organizations must simultaneously manage multiple temporal rhythms that often conflict.

Paper III's findings show that crisis response can mature into strategic capabilities offers a more optimistic view of path dependency. The communication channels, trust relationships, and problem-solving routines developed for shortage management provided unexpected foundations for circular initiatives. However, this maturation is

selective and unpredictable; end-of-life practices like component rebaking could leverage crisis-created capabilities, while design-phase circularity required entirely new collaborative frameworks incompatible with crisis-driven urgency.

Unintended consequences

The unintended consequences documented across all three papers reveal that alignment interventions in multi-tier supply chains generate cascading effects that ripple through the supply network, often producing outcomes opposite to those intended. Transitional triads solve information asymmetry between OEMs and Tier-2s but create role ambiguity for Tier-1 suppliers, who lose their information monopoly while retaining integration responsibilities, what Paper I terms the "dual-agent shadow." This shadow effect extends throughout the network: Tier-2 suppliers gain direct OEM access but must now manage conflicting demands from multiple channels; OEMs achieve transparency but face increased coordination complexity; Tier-1 suppliers must redefine their value proposition while managing diminished bargaining power.

The institutionalization of crisis response creates also unintended consequences. Paper II documents how the procurement semiconductor taskforce, initially a temporary crisis response, evolved into a permanent structure that now works with technology during stable periods. The formal strategic business agreements between OEMs and Tier-2s, designed to prevent future shortages through long-term commitments, are redundant when the supply increases. These mechanisms optimized for one context, crisis management, may become ineffective in another context, normal operations.

Paper III's "accidental circularity" represents a counterintuitive unintended consequence. Circular practices emerged not from deliberate sustainability strategies but as economic responses to crisis conditions. Component rebaking began as a shortage mitigation tactic; remanufacturing developed from cost pressures rather than environmental commitments. These finding challenges assumptions in sustainable supply chain literature about the dominance of environmental values in driving circular transitions. Instead, it suggests effective circularity strategies should identify and amplify circular potential within existing economic operations rather than imposing external sustainability frameworks.

Theoretical implications of multi-tier alignment

The synthesis across papers demands reconceptualization of alignment theory for multi-tier contexts. Alignment must be understood not as an achievable state (Skipworth *et al.*, 2015; Wong *et al.*, 2012) but as a continuous process of managing interdependent alignment mechanisms that create new misalignments while resolving others (Lundin and Norrman, 2010). The oscillation, structural adaptations triggering dialectical responses, formal controls generating relational compensation, transparency creating coordination complexity, suggests equilibrium models are inappropriate for multi-tier contexts. Instead, multi-tier alignment must move from seeking optimal configurations toward managing different alignment mechanisms simultaneously, knowing which mechanisms to deploy when, how they will interact with existing structures, and what unintended consequences to anticipate and manage.

Context-specific alignment: resilience versus circularity

The major difference between alignment mechanisms for resilience and circularity reveals that strategic context doesn't merely influence which mechanisms are deployed but determines how they operate, interact, and develop. Resilience-driven alignment operates through crisis logic characterized by urgency, reactivity, and optimization for speed over efficiency. The semiconductor shortage demanded daily allocation decisions, immediate inventory deployments, and rapid structural adaptations measured in days or weeks. This temporal pressure drives toward centralized decision-making, information hoarding despite transparency initiatives, and bilateral fixes that fragment overall network coordination.

Circularity alignment requires an entirely different operational logic: patient, proactive, and optimized for lifecycle effectiveness over transactional efficiency. Modular PCB development spans multiple product generations, requiring sustained collaboration through design iterations where success metrics shift from cost-per-unit to value-across-lifecycles. This long-term orientation enables distributed innovation, where Tier-2 suppliers' material expertise, Tier-1's integration capabilities, and OEMs' market knowledge combine in ways impossible under crisis-driven urgency. The difference between these logics explains why firms take so long transition towards circularity.

The alignment mechanisms themselves embody these different logics. Resilience related alignment mechanisms are based on collaboration and quick non-contractual. While circularity related alignment mechanisms are based on collaboration that takes time and might be more contractual. This comparison addresses a gap in existing literature that assumes governance mechanisms operate consistently regardless of strategic objectives (Chae *et al.*, 2024; Villena and Gioia, 2018). Consequently, this means that firms must develop parallel governance systems with different operational principles, success metrics, and temporal horizons.

5.1. Answering the research questions

The findings across the three papers provide complementary perspectives on both research questions, revealing how misalignments manifest and how alignment mechanisms interact and develop in multi-tier supply chains. Table 6 synthesizes the key findings and contributions of each paper in relation to research questions and core theoretical concepts.

RQ1: How are misalignments characterized and what alignment mechanisms are employed across multiple tier automotive electronics supply chain?

Characterization of Misalignments

Paper I provides the primary contribution to understanding how misalignments are characterized in multi-tier supply chains. The comprehensive typology identifying four levels of misalignment (incentive, functional, operational, and strategic) extends existing alignment literature that has primarily focused on single dimensions (Skipworth *et al.*, 2015; Wong *et al.*, 2012). While Narayanan and Raman (2004) identified incentive misalignments arising from hidden actions and information, Paper I demonstrates how these incentive issues in automotive electronics supply chains are rooted in incompatible contractual structures. The finding that OEMs maintain flexible contracts without volume

commitments while semiconductor suppliers require long-term capacity commitments reveals a structural incompatibility not captured in traditional agency theory applications (Yang *et al.*, 2022).

Table 6: Synthesis of findings and contributions across papers

Dimension	Paper I	Paper II	Paper III
Contribution to RQ1	Identifies four misalignment levels (incentive, functional, operational, strategic) and shows structural change from open to transitional triads as the main alignment mechanism.	Reveals how mechanisms unfold over time: crisis taskforces to permanent teams; informal links to formal agreements; reactive data sharing to routine exchanges.	Demonstrates collaboration as the foundational mechanism enabling five circular practices, each with different actor configurations and resource needs.
Contribution to RQ2	Establishes a cyclical view of alignment $A(t + 1) = \min\{1, A(t) – x + C\}$; transitional triads solve some misalignments while generating new ones.	Traces a dialectical pattern across three thesis–antithesis–synthesis episodes, oscillating between contractual and relational mechanisms.	Shows how crisis-driven mechanisms mature into strategic capabilities, with different speed between design-phase and end-of-life interventions.
Theoretical concepts advanced	Dual-agent shadow: Tier-1 loses information monopoly but keeps operational responsibility; transitional triads emerge as persistent governance forms.	Mechanism oscillation: each intervention triggers compensatory responses.	Accidental circularity, where disruption- and cost-driven problem-solving unintentionally creates circular practices; circularity not always focal firm dependent.
Alignment mechanisms identified	Non-contractual: structural change with e.g.: three-party meetings, dedicated semiconductor teams, BOM transparency.	Contractual, e.g.: flexible contracts, buffer clauses, strategic business agreements. Non contractual, e.g.: key-account roles, information protocols, trust-building.	Collaboration as foundation of contractual and non-contractual mechanisms, e.g.: joint design, shared test infrastructure.

The functional misalignments identified in Paper I extend beyond the internal coordination issues documented by Kumar et al. (2020) and Chehbi-Gamoura et al. (2020). While these authors focus on misalignment between sales and supply chain functions, Paper I reveals how the semiconductor crisis exposed deeper functional fragmentation between procurement and R&D teams, resulting in knowledge gaps about component obsolescence and technology roadmaps. This finding suggests that functional alignment in multi-tier contexts requires not just internal coordination but also technical competence to engage with lower-tier suppliers effectively.

Paper II partially contributes to RQ1 by revealing how misalignments manifest differently over time. The longitudinal analysis shows that operational misalignments between just-in-time automotive systems and batch semiconductor production, while always present, only became problematic during crisis conditions. This temporal dimension extends McAdam et al.'s (2014) work on misalignment in performance measurements by demonstrating how hidden misalignments may pass unnoticed until they are activated by external disruptions. The dialectical episodes identified, particularly the conflict between flexible contracts and volume commitments, demonstrate that misalignments are not static problems but evolving tensions requiring continuous management.

Paper III's contribution to characterizing misalignments is more implicit but important. The finding that OEMs resist circular practices due to quality concerns while Tier-1 suppliers drive innovation reveals a strategic misalignment not captured in traditional

alignment frameworks. This extends Dangol et al.'s (2024) work on strategy-relationship misalignment by showing how sustainability objectives can create new forms of misalignment where traditional hierarchies impede innovation. The "accidental circularity" phenomenon, where crisis-driven practices enable sustainable outcomes, suggests that misalignments can paradoxically create opportunities for strategic transformation.

Identification of Alignment Mechanisms

The alignment mechanisms identified across the three papers extend our understanding of suggested by existing literature's dichotomy between contractual and relational governance (Cao and Lumineau, 2015; Roehrich *et al.*, 2020). Paper I's primary contribution lies in documenting structural mechanisms, specifically the transition from open to transitional triads, as an alignment mechanism. This finding extends Mena et al.'s (2013) triadic typology by demonstrating that transitional triads are not merely intermediate structures but can serve as persistent governance solutions.

The specific mechanisms documented in Paper I, three-party meetings, direct program file exchanges, dedicated semiconductor teams, and cross-tier audits, represent hybrid forms that blur traditional governance categories. Unlike the clear separation between formal and informal mechanisms assumed in prior literature (Poppo and Zenger, 2002), these mechanisms combine elements of both. Three-party meetings have formal agendas but informal dynamics; semiconductor teams have official mandates but rely on personal relationships. This finding suggests that effective multi-tier alignment requires governance innovation beyond traditional categories.

Paper II enriches our understanding of alignment mechanisms by revealing their temporal deployment patterns. The evolution from crisis taskforces to permanent semiconductor procurement teams demonstrates what Lundin and Norrman (2010) suggested but did not empirically document, that alignment mechanisms develop rather than simply accumulate. The finding that informal OEM–Tier-2 relationships established during crisis gradually formalize into strategic business agreements supports Selviaridis and Spring's (2018) processual view while adding specificity about the formalization trajectory. However, Paper II also reveals that some mechanisms resist formalization; the flexible contracting philosophy persists despite acknowledged problems, suggesting path dependencies that constrain mechanism evolution.

Paper III contributes to RQ1 by identifying collaboration as a foundation to alignment mechanisms. While Cao and Zhang (2011) conceptualize collaboration through seven dimensions, Paper III's empirical cases reveal how collaboration manifests differently across circularity initiatives. The finding that successful circular practices require actor-specific resource contributions (e.g.: OEM logistics networks, Tier-1 testing capabilities, Tier-2 storage infrastructure) extends perspectives on collaboration (Soosay and Hyland, 2015).

RQ2: How do alignment mechanisms develop and interact over time across multiple tiers in automotive electronics supply chain?

Development of alignment mechanisms

Paper II provides the primary empirical evidence for understanding temporal evolution through its longitudinal analysis spanning 2020-2025. The dialectical process framework reveals evolution patterns more complex than the linear progression or cyclical models suggested in existing literature. While Van de Ven and Poole (1995) theorize dialectical change, Paper II demonstrates its specific manifestation in supply chain contexts through three concrete episodes. Each episode shows how opposing forces (thesis-antithesis) create tensions that drive mechanism evolution, but the synthesis achieved is temporary and unstable, generating new contradictions.

The first dialectical episode (just-in-time versus long-term planning) illustrates how alignment mechanisms develop through forced compromise rather than optimization. The alignment mechanisms emerging from this tension (e.g. Key Account Manager roles, formalized information protocols) represent what Putnam et al. (2016) call "working through paradox" rather than resolving it. Unlike Kocabasoglu-Hillmer et al.'s (2023) suggestion that firms must choose between competing objectives, Paper II shows how alignment mechanisms enable temporary coexistence of contradictory logics. However, this coexistence requires continuous effort; when crisis pressure subsided, partners reverted to pre-crisis patterns despite acknowledged inefficiencies.

Paper I contributes to understanding evolution by establishing the cyclical nature of alignment through the mathematical formulation $A(t+1) = \min\{1, A(t)-x+C\}$. This model extends Lundin and Norrman's (2010) conceptual insight about alignment creating misalignment by providing a mechanism for the cycle. Each alignment intervention C addresses specific misalignments x but disrupts existing equilibria, creating new misalignments. The transitional triad formation exemplifies this: establishing direct OEM–Tier-2 links reduces information asymmetry but creates role ambiguity for Tier-1 suppliers. This finding challenges the view of alignment as progressing toward an optimal state, suggesting instead that supply chains oscillate between alignment and misalignment as Paper II suggests.

Paper III's contribution to temporal understanding focuses on how crisis-driven mechanisms help strategic transformations as the one towards circularity. The evolution from emergency semiconductor allocation (rebaking obsolete inventory) to circular practices shows that. However, unlike planned capability development, these transformations are opportunistic and not systematic. Only cases where economic incentives aligned with sustainability objectives showed sustained evolution, supporting Zehendner et al.'s (2021) finding that economic-environmental tensions must be actively managed rather than assumed to naturally align.

Interaction of alignment mechanisms

Paper II's processual analysis reveals interaction patterns between contractual and non-contractual alignment mechanisms shows that they rarely settle into a fixed complementary or substitutive role. Paper II documents oscillation, a recursive pattern where each mechanism type triggers compensatory deployment of the other. When OEMs

impose contractual requirements (mandatory buffers), suppliers respond with relational investments (three party meetings) to settle relationships. Like recent studies show governance oscillates: contractual tightening can crowd out trust, which later resurfaces to repair cooperation (Fang *et al.*, 2024). Similar reversals occur when disruption alters hazard salience, prompting partners to cycle from relational fixes back to formal clauses (Keller *et al.*, 2021). Multi-tier analyses likewise show that once indirect transactions are considered, contracts and relational ties become interdependent rather than strictly complementary (Chae *et al.*, 2024). This oscillation differs from the stable complementarity found in dyadic studies, suggesting that multi-tier contexts create different interaction dynamics.

Second, agency theory requires modification for multi-tier applications., or where innovation leadership shifts from OEMs to suppliers depending on the specific circular practice. Multi-tier agency theory must account for distributed agency where multiple actors hold partial principal and agent roles simultaneously.

Paper I contributes to understanding interaction by demonstrating how structural mechanisms (transitional triads) create new contexts for other mechanisms. The establishment of direct OEM–Tier-2 links does not simply add a communication channel but alters how existing mechanisms function. Information sharing between OEM and Tier-1 takes on different meanings when both parties know the OEM has independent Tier-2 access. The "dual-agent shadow" concept, reveals that agency positions in multi-tier networks are fluid, overlapping, and often contradictory extending double agency model of Wilhelm et al., 2016. Traditional principal-agent frameworks cannot capture situations where Tier-1 suppliers simultaneously lose information monopoly and retain operational accountability. This finding extends Yang et al.'s (2022) work on triadic agency by showing how structural changes create changed functioning of existing mechanisms due to new structural contexts.

Paper III reveals interaction patterns specific to collaboration as mechanisms, showing how different circular practices require distinct mechanism combinations. Design-phase collaboration (modular PCBs) requires patient trust-building and technical knowledge sharing, incompatible with the urgent information exchange driving shortage response. End-of-life practices (rebaking) can leverage crisis-created capabilities but require different incentive structures. This finding challenges generic collaboration frameworks (Cao and Zhang, 2011) by demonstrating that mechanism interactions are objective-specific rather than universally applicable.

6. Conclusion

This thesis investigated how alignment mechanisms emerge, interact, and develop in multi-tier automotive electronics supply chains, using the empirical contexts of the semiconductor shortage crisis and circularity transitions. Through three complementary studies employing case study methodology and combining qualitative analysis, this research has provided new insights into the dynamic and processual nature of supply chain alignment. This concluding chapter synthesizes the theoretical contributions, practical implications, limitations, and future research directions emerging from this work.

6.1. Thesis contributions

The first contribution of this thesis is to the existing perspective of alignment in supply chain alignment literature (Skipworth *et al.*, 2015; Wong *et al*., 2012) by demonstrating that alignment is not an achievable state but a perpetual process. While Selviaridis and Spring (2018) conceptualized alignment as process rather than state, this thesis extends their work by providing the specific mechanism through which this process operates, the alignment-misalignment cycle formalized as $A(t+1) = \min\{1, A(t)-x+C\}$. This mathematical formulation advances Lundin and Norrman's (2010) observation about unintended consequences by showing precisely how each intervention generates predictable patterns of new misalignments. Unlike existing literature that treats misalignment as a problem to be solved, this thesis reconceptualizes misalignment as an inherent feature of multi-tier alignment. Where it must be continuously managed rather than eliminated.

The second contribution of this thesis is extending the multi-tier supply chain management literature beyond structural typologies (Mena *et al.*, 2013) and governance mechanisms (Chae *et al.*, 2024) by revealing how alignment mechanisms embody different operational logics depending on strategic objectives. While existing literature assumes governance mechanisms operate consistently across contexts (Villena and Gioia, 2018), this thesis demonstrates that resilience-driven mechanisms (reactive, short-term, crisis-focused) and circularity-enabling mechanisms (proactive, long-term, transformation-focused) require different approaches. This finding extends recent calls for multiple multi-tier supply chains (Gong *et al.*, 2023) by showing that organizations must simultaneously apply different alignment logics.

Third, the thesis extends agency theory's application to multi-tier supply chains by introducing the "dual-agent shadow" concept, which advances beyond Wilhelm et al.'s (2016) double agency framework. While Wilhelm et al. describe Tier-1 suppliers as simultaneously serving as agents to OEMs and principals to Tier-2s, this thesis reveals a more complex reality where transitional triads create overlapping and contradictory agency positions and extends Yang et al.'s (2022) work on triadic agency by showing how structural changes alter the meaning of agency without changing formal contractual relationships.

Finally, the dialectical process and oscillation between contractual and non-contractual mechanisms challenges both complementarity and substitution perspectives in governance literature. While Cao and Lumineau (2015) argue contracts and relationships complement each other, and Poppo and Zenger (2002) suggest they can substitute, this

research reveals a dialectical relationship where each mechanism type generates demand for its opposite. The pattern observed, contractual tightening and relational investments, which enables further formalization extends recent work by Fang et al. (2024) on governance adjustments.

6.2. Practical implications

For procurement and supply chain professionals, this thesis provides insights into managing alignment in technologically complex, rapidly changing environments. The first key implication is that practitioners must abandon the pursuit of stable alignment states and instead develop capabilities for continuous realignment. The never-ending cycle of alignment-misalignment means that procurement professionals need competencies in wider supply network thinking beyond first tier suppliers, and adaptive governance rather than just traditional skills in negotiation and contract management. Specifically, the findings suggest that procurement teams should establish alignment monitoring systems that track not just performance metrics but also emerging tensions and unintended consequences of alignment interventions. The semiconductor procurement teams that developed from crisis task forces to permanent organizational structures provide a model for institutionalizing this continuous realignment capability.

Second, the findings reveal that managing multi-tier relationships requires different approaches than traditional supplier management. The "dual-agent shadow" phenomenon means that procurement cannot simply bypass Tier-1 suppliers to engage directly with Tier-2, as this increases governance resources. Instead, practitioners should develop collaboration structures where roles and responsibilities are explicitly negotiated and continuously adjusted rather than assumed from traditional supply chain positions. For procurement professionals, this means developing skills in orchestrating complex, multi-party relationships where traditional hierarchies are replaced by adjusting role configurations.

Third, the contrast between alignment for resilience and alignment for circularity provides practical guidance for managing multiple strategic objectives simultaneously. Practitioners should recognize that crisis-driven alignment mechanisms, while effective for immediate problem-solving, may actually hinder long-term strategic transitions like circularity. The finding that semiconductor shortages created infrastructure for circular practices through suggests that procurement professionals should explicitly plan for designing crisis responses with future strategic applications in mind. Moreover, the regional clustering of successful circular practices implies that global procurement strategies must be balanced with local collaboration. Procurement organizations should develop distinct but linked capabilities for managing global efficiency, regional circularity, and crisis resilience, recognizing that these objectives require different alignment mechanisms.

6.3. Limitations and further research

This thesis, while providing valuable insights into alignment mechanisms in multi-tier supply chains, faces several limitations that must be acknowledged. First, the limited empirical focus two supply networks within the specific context of automotive electronics limits the generalizability of findings. While the automotive semiconductor supply chain represents an extreme case of technological complexity and multi-tier challenges, other

industries may exhibit different alignment dynamics. The unique characteristics of semiconductors: high capital intensity, long lead times, and concentrated manufacturing; create specific alignment challenges that may not translate to other industries. Furthermore, the European automotive context, with its particular regulatory environment and established supplier relationships, may not reflect alignment patterns in other geographical regions or emerging automotive markets.

Second, the temporal boundaries of the study, while capturing the key semiconductor crisis period, may not fully reveal longer-term alignment evolution patterns. Paper II's longitudinal analysis covers 2020-2025, but alignment mechanisms may exhibit different dynamics over decades-long time horizons. Additionally, the ongoing nature of the circularity transition means that Paper III captures early-stage collaborations z that may develop significantly as circular practices mature. The limitation of studying alignment during a period of extreme disruption may overemphasize reactive mechanisms while underrepresenting proactive, strategic alignment approaches that emerge during stable periods.

Third, methodological limitations arise from the reliance on primarily qualitative data and retrospective accounts for historical periods. While triangulation with documents and multiple informants was employed, recall bias may affect accounts of pre-crisis alignment mechanisms. The case study methodology, while enabling deep contextual understanding, limits statistical generalization and the ability to test causal relationships between alignment mechanisms and performance outcomes.

This thesis opens several promising avenues for future research on alignment in multi-tier supply chains. First, comparative studies across different industries and technological contexts could test the boundaries of the never-ending alignment-misalignment cycle. Research could examine whether the mathematical formulation $A(t+1) = \min\{1, A(t)-x+C\}$ holds in less technologically complex supply chains or whether certain industry characteristics enable more stable alignment states. Particularly valuable would be studies comparing alignment mechanisms in industries with different power distributions, such as retail (buyer-dominated). Additionally, cross-cultural studies could explore how institutional contexts influence alignment mechanism effectiveness, particularly comparing high-trust societies with more contractually oriented business environments.

Second, future research could employ ethnographic or action research approaches to capture alignment evolution as it occurs rather than through retrospective analysis. The development of dynamic modeling techniques, such as system dynamics or agent-based modeling, could formalize the recursive relationships between different alignment mechanisms and predict emergent outcomes. Particularly important is understanding the temporal boundaries of crisis memory and identifying interventions that can sustain beneficial alignment mechanisms beyond immediate triggers. Research could also explore whether certain sequencing of alignment mechanisms proves more effective than others, developing temporal theories of mechanism deployment.

Third, this thesis touched on information sharing mechanisms, but emerging technologies like blockchain, artificial intelligence, and digital twins could alter alignment dynamics in multi-tier supply chains. Research could explore whether digital technologies enable new forms of alignment that transcend the physical and temporal

constraints identified in this thesis. For instance, can AI-enabled demand sensing reduce the operational misalignments between automotive and semiconductor planning horizons? Can blockchain-based smart contracts create self-executing alignment mechanisms that adapt automatically to changing conditions? Additionally, research should examine whether digital technologies create new forms of misalignment, such as algorithmic bias or cyber-vulnerability cascades across tiers. These questions become particularly important as supply chains undergo digital transformation while simultaneously pursuing resilience and sustainability objectives.

References

Agndal, H., Arvidsson, A. and Nilsson, U. (2023), "Managing appropriation concerns and coordination costs in complex vendor relationships: Integration and isolation as governance strategies", *Industrial Marketing Management*, Vol. 113, pp. 116–127, doi: 10.1016/j.indmarman.2023.05.023.

Agyemang, M., Zhu, Q., Adzanyo, M., Antarciuc, E. and Zhao, S. (2018), "Evaluating barriers to green supply chain redesign and implementation of related practices in the West Africa cashew industry", *Resources, Conservation and Recycling*, Vol. 136, pp. 209–222, doi: 10.1016/j.resconrec.2018.04.011.

Alexander, A., Kumar, M. and Walker, H. (2018), "A decision theory perspective on complexity in performance measurement and management", *International Journal of Operations & Production Management*, Emerald Publishing Limited, Vol. 38 No. 11, pp. 2214–2244, doi: 10.1108/IJOPM-10-2016-0632.

Alqahtani, F., Selviaridis, K. and Stevenson, M. (2024), "How incentive alignment along the supply chain fosters incremental innovation: evidence from defence performance-based contracts", *International Journal of Operations & Production Management*, Emerald Publishing Limited, Vol. 45 No. 6, pp. 1250–1275, doi: 10.1108/IJOPM-01-2024-0064.

Alvesson, M. and Sköldberg, K. (2018), *Reflexive Methodology: New Vistas for Qualitative Research*, Third edition., SAGE, London Los Angeles New Delhi Singapore Washington DC Melbourne.

Anderson, P. (1999), "Perspective: Complexity Theory and Organization Science", *Organization Science*, Vol. 10 No. 3, pp. 216–232, doi: 10.1287/orsc.10.3.216.

Arora, A., Waas, A., Palma, R., Feng, J., Breidenbach, K., Xue, H., Jesse, E., *et al.* (2022), *Tracking the Next Phase of the Automotive Semiconductor Shortage*, Boston Consulting Group, Boston.

Automotive Logistics & Supply Chain. (2023), "Interview: Infineon's Dr. Birgit Fuchs on the digital tools being used for semiconductor capacity planning", Automotive Logistics, 8 November, available at: https://www.automotivelogistics.media/red-sofa-interviews/red-sofa-interview-infineons-birgit-fuchs-on-the-digital-tools-being-used-for-semiconductor-capacity-planning/192889.

Batista, L., Seuring, S., Genovese, A., Sarkis, J. and Sohal, A. (2023), "Theorising circular economy and sustainable operations and supply chain management: a sustainability-dominant logic", *International Journal of Operations & Production Management*, Vol. 43 No. 4, pp. 581–594, doi: 10.1108/IJOPM-12-2022-0765.

Bauernhansl, T., Beck, M., Lesmeister, F. and Spindelndreier, D. (2020), "The Proximity Paradox: Balancing Auto Suppliers' Manufacturing Networks", *BCG Global*, 19 August, available at: https://www.bcg.com/publications/2015/automotive-proximity-paradox-balancing-auto-supplier-manufacturing-networks (accessed 3 August 2025).

Bell, E., Bryman, A. and Harley, B. (2022), *Business Research Methods*, Sixth edition., Oxford University Press, Oxford, United Kingdom New York, NY.

Bennett, D. and Klug, F. (2012), "Logistics supplier integration in the automotive industry", *International Journal of Operations & Production Management*, Emerald Group Publishing Limited, Vol. 32 No. 11, pp. 1281–1305, doi: 10.1108/01443571211274558.

Berlin, D., Feldmann, A. and Nuur, C. (2022), "Supply network collaborations in a circular economy: A case study of Swedish steel recycling", *Resources, Conservation and Recycling*, Vol. 179, p. 106112, doi: 10.1016/j.resconrec.2021.106112.

Bhaskar, R. (2008), *A Realist Theory of Science*, Routledge, London.

Bimpikis, K., Fearing, D. and Tahbaz-Salehi, A. (2018), "Multisourcing and Miscoordination in Supply Chain Networks", *Operations Research*, INFORMS, Vol. 66 No. 4, pp. 1023–1039, doi: 10.1287/opre.2017.1708.

Bocken, N., Pinkse, J., Ritala, P. and Darnall, N. (2025), "Moving Beyond Circular Utopia and Paralysis: Accelerating Business Transformations Towards the Circular Economy", *Organization & Environment*, SAGE Publications Inc, Vol. 38 No. 2, pp. 91–108, doi: 10.1177/10860266251346251.

Bowen, G.A. (2009), "Document Analysis as a Qualitative Research Method", *Qualitative Research Journal*, Emerald Group Publishing Limited, Vol. 9 No. 2, pp. 27–40, doi: 10.3316/QRJ0902027.

Braz, A.C. and de Mello, A.M. (2024), "Supply chain management strategies, types and tactics for circular economy transitions", *Management Review Quarterly*, Vol. 74 No. 4, pp. 2121–2148, doi: 10.1007/s11301-023-00354-4.

Bressanelli, G., Pigosso, D.C.A., Saccani, N. and Perona, M. (2021), "Enablers, levers and benefits of Circular Economy in the Electrical and Electronic Equipment supply chain: a literature review", *Journal of Cleaner Production*, Vol. 298, p. 126819, doi: 10.1016/j.jclepro.2021.126819.

Brinley, S. (2023), "The semiconductor shortage is – mostly – over for the auto industry", *S&P Global Mobility*, 12 July, available at: https://www.spglobal.com/mobility/en/research-analysis/the-semiconductor-shortage-is-mostly-over-for-the-auto-industry.html (accessed 8 July 2025).

Burkacky, O., Deichmann, J., Guggenheimer, M. and Kellner, M. (2023), *Outlook on the Automotive Software and Electronics Market through 2030*, McKinsey.

Burkacky, O., Deichmann, J., Pfingstag, P. and Werra, J. (2022), *Semiconductor Shortage: How the Automotive Industry Can Succeed*, McKinsey & Company, New York.

Cachon, G.P. and Lariviere, M.A. (2005), "Supply Chain Coordination with Revenue-Sharing Contracts: Strengths and Limitations", *Management Science*, Vol. 51 No. 1, pp. 30–44, doi: 10.1287/mnsc.1040.0215.

Calicchio Berardi, P. and Peregrino de Brito, R. (2021), "Supply chain collaboration for a circular economy - From transition to continuous improvement", *Journal of Cleaner Production*, Vol. 328, p. 129511, doi: 10.1016/j.jclepro.2021.129511.

Calzolari, T., Genovese, A., Brint, A. and Seuring, S. (2024), "Unlocking circularity: the interplay between institutional pressures and supply chain integration", *International Journal of Operations & Production Management*, Emerald Publishing Limited, Vol. 45 No. 2, pp. 517–541, doi: 10.1108/IJOPM-10-2023-0860.

Cao, M. and Zhang, Q. (2011), "Supply chain collaboration: Impact on collaborative advantage and firm performance", *Journal of Operations Management*, Vol. 29 No. 3, pp. 163–180, doi: 10.1016/j.jom.2010.12.008.

Cao, S., Bryceson, K. and Hine, D. (2021), "Collaborative risk management in decentralised multi-tier global food supply chains: an exploratory study", *The International Journal of Logistics Management*, Vol. 32 No. 3, pp. 1050–1067, doi: 10.1108/IJLM-07-2020-0278.

Cao, Z. and Lumineau, F. (2015), "Revisiting the interplay between contractual and relational governance: A qualitative and meta-analytic investigation", *Journal of Operations Management*, Vol. 33–34, pp. 15–42, doi: 10.1016/j.jom.2014.09.009.

Carey, S., Lawson, B. and Krause, D.R. (2011), "Social capital configuration, legal bonds and performance in buyer–supplier relationships", *Journal of Operations Management*, Vol. 29 No. 4, pp. 277–288, doi: 10.1016/j.jom.2010.08.003.

Chae, S., Choi, T.Y. and Hoetker, G. (2024), “Theorizing the governance of direct and indirect transactions in multi-tier supply chains”, *Journal of Supply Chain Management*, Vol. 60 No. 2, pp. 3–21, doi: 10.1111/jscm.12318.

Chatha, K.A. and Butt, I. (2015), “Themes of study in manufacturing strategy literature”, *International Journal of Operations & Production Management*, Vol. 35 No. 4, pp. 604–698, doi: 10.1108/IJOPM-07-2013-0328.

Chehbi-Gamoura, S., Derrouiche, R., Damand, D. and Barth, M. (2020), “Insights from big Data Analytics in supply chain management: an all-inclusive literature review using the SCOR model”, *Production Planning & Control*, Taylor & Francis, Vol. 31 No. 5, pp. 355–382, doi: 10.1080/09537287.2019.1639839.

Choi, T.Y. and Hong, Y. (2002), “Unveiling the structure of supply networks: case studies in Honda, Acura, and DaimlerChrysler”, *Journal of Operations Management*, Vol. 20 No. 5, pp. 469–493, doi: 10.1016/S0272-6963(02)00025-6.

Choi, T.Y., Narayanan, S., Novak, D., Olhager, J., Sheu, J.-B. and Wiengarten, F. (2021), “Managing extended supply chains”, *Journal of Business Logistics*, Vol. 42 No. 2, pp. 200–206, doi: 10.1111/jbl.12276.

Choi, T.Y. and Wu, Z. (2009), “Triads in Supply Networks: Theorizing Buyer–Supplier–Supplier Relationships”, *Journal of Supply Chain Management*, Vol. 45 No. 1, pp. 8–25, doi: 10.1111/j.1745-493X.2009.03151.x.

Creswell, J.W. and Miller, D.L. (2000), “Determining Validity in Qualitative Inquiry”, *Theory Into Practice*, Routledge, Vol. 39 No. 3, pp. 124–130, doi: 10.1207/s15430421tip3903_2.

Cui, L., Wu ,Hao and and Dai, J. (2023), “Modelling flexible decisions about sustainable supplier selection in multitier sustainable supply chain management”, *International Journal of Production Research*, Taylor & Francis, Vol. 61 No. 14, pp. 4603–4624, doi: 10.1080/00207543.2021.1924412.

Dangol, R., Eunni, R.V., Bateman, P.J. and Marculetiu, A. (2024), “Aligning cooperative supply chain relationships with firm strategy: a cross-disciplinary analysis”, *Management Research Review*, Vol. 47 No. 8, pp. 1268–1285, doi: 10.1108/MRR-08-2023-0614.

Dattée, B., Arrègle, J.-L., Barbieri, P., Lawton, T.C. and Angwin, D.N. (2022), “The Dynamics of Organizational Autonomy: Oscillations at Automobili Lamborghini”, *Administrative Science Quarterly*, Vol. 67 No. 3, pp. 721–768, doi: 10.1177/00018392221091850.

De Angelis, R., Howard, M. and Miemczyk, J. (2018), “Supply chain management and the circular economy: towards the circular supply chain”, *Production Planning & Control*, Vol. 29 No. 6, pp. 425–437, doi: https://doi.org/10.1080/09537287.2018.1449244.

Dubois, A. and Gadde, L.-E. (2002), “Systematic combining: an abductive approach to case research”, *Journal of Business Research*, Vol. 55 No. 7, pp. 553–560, doi: 10.1016/S0148-2963(00)00195-8.

Easton, G. (2010), “Critical realism in case study research”, *Industrial Marketing Management*, Vol. 39 No. 1, pp. 118–128, doi: 10.1016/j.indmarman.2008.06.004.

Eisenhardt, K.M. (1989), “Agency Theory: An Assessment and Review”, *The Academy of Management Review*, Vol. 14 No. 1, p. 57, doi: 10.2307/258191.

Eisenhardt, K.M. (2021), “What is the Eisenhardt Method, really?”, *Strategic Organization*, Vol. 19 No. 1, pp. 147–160, doi: 10.1177/1476127020982866.

Eisenhardt, K.M. and Graebner, M.E. (2007), “Theory Building From Cases: Opportunities And Challenges”, *Academy of Management Journal*, Vol. 50 No. 1, pp. 25–32, doi: 10.5465/amj.2007.24160888.

European Commission. (2015), “Closing the loop: Commission adopts ambitious new Circular Economy Package to boost competitiveness, create jobs and generate sustainable growth”.
European Commission. (2020), *A New Circular Economy Action Plan for a Cleaner and More Competitive Europe (COM/2020/98 Final)*, European Commission, Brussels.
European Commission. (2022), *Questions and Answers: Commission Proposal on the New Euro 7 Standards*, European Commission, Brussels.
European Commission. (2022), *Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL Establishing a Framework of Measures for Strengthening Europe’s Semiconductor Ecosystem (Chips Act)*.
European Commission. (2023), *Proposal for a Regulation on Circularity Requirements for Vehicle Design and End-of-Life Vehicles (COM(2023) 451 Final)*, European Commission, Brussels.
Falcone, E.C., Barker, J.M. and Chen, H. (2025), “Cross-Tier Supplier Collaboration on Buyer Firm Innovation Performance: The Moderating Role of Geographic Distance and Relationship Longevity”, *Journal of Business Logistics*, Vol. 46 No. 2, p. e70010, doi: 10.1111/jbl.70010.
Falcone, P.M. and Tutore, I. (2025), “Mapping the Nexus: A Bibliometric Analysis and Social Network Analysis of Transformative Innovation Policies and Sustainable Development Goals”, *Business Strategy and the Environment*, Vol. 34 No. 2, pp. 2423–2435, doi: 10.1002/bse.4104.
Fang, F., van der Valk, W., Vos, B. and Akkermans, H.A. (2024), “Down the drain: The dynamic interplay of governance adjustments addressing setbacks in large public–private projects”, *Journal of Operations Management*, Vol. 70 No. 1, pp. 80–106, doi: 10.1002/joom.1277.
Faruquee, M., Paulraj, A., Zhang, L. and Irawan, C.A. (2025), “Formal or informal governance mechanism: a contingent view in resolving supply chain disruptions”, *International Journal of Operations & Production Management*, Emerald Publishing Limited, Vol. 45 No. 8, pp. 1510–1548, doi: 10.1108/IJOPM-04-2024-0347.
Fayezi, S., O’Loughlin, A. and Zutshi, A. (2012), “Agency theory and supply chain management: a structured literature review”, edited by Wilding, R. and Wagner, B.*Supply Chain Management: An International Journal*, Emerald Group Publishing Limited, Vol. 17 No. 5, pp. 556–570, doi: 10.1108/13598541211258618.
Flygansvær, B., Dahlstrom, R. and Nygaard, A. (2018), “Exploring the pursuit of sustainability in reverse supply chains for electronics”, *Journal of Cleaner Production*, Vol. 189, pp. 472–484, doi: 10.1016/j.jclepro.2018.04.014.
Forslund, H., Björklund, M. and Ülgen, V.S. (2021), “Challenges in extending sustainability across a transport supply chain”, *Supply Chain Management: An International Journal*, Emerald Publishing Limited, Vol. 27 No. 7, pp. 1–16, doi: 10.1108/SCM-06-2020-0285.
Franke, H., Eckerd, S. and Foerstl, K. (2022), “Rising to the Top: Motivational Forces Influencing Status Conflict in Sourcing Teams”, *Production and Operations Management*, SAGE Publications, Vol. 31 No. 3, pp. 963–983, doi: 10.1111/poms.13590.
Franke, H., Foerstl, K. and Heese, H.S. (2021), “The Interaction Effect of Goal Misalignment and Metaknowledge Distribution on Team Decision Making in Operations and Supply Chain Management”, *Decision Sciences*, Vol. 52 No. 2, pp. 331–361, doi: 10.1111/deci.12439.

Ganesh, M., Raghunathan, S. and Rajendran, C. (2014), “Distribution and Equitable Sharing of Value From Information Sharing Within Serial Supply Chains”, *IEEE Transactions on Engineering Management*, presented at the IEEE Transactions on Engineering Management, Vol. 61 No. 2, pp. 225–236, doi: 10.1109/TEM.2013.2271534.

Garcia, J.A.C., Arvidsson, A. and Jonsson, P. (2024), “An analysis of automakers navigating an evolving semiconductor landscape”, *International Journal of Physical Distribution & Logistics Management*, Emerald Publishing Limited, Vol. 54 No. 6, pp. 586–609, doi: 10.1108/IJPDLM-11-2023-0412.

Gebhardt, M., Beck, J., Kopyto, M. and Spieske, A. (2022), “Determining requirements and challenges for a sustainable and circular electric vehicle battery supply chain: A mixed-methods approach”, *Sustainable Production and Consumption*, Vol. 33, pp. 203–217, doi: 10.1016/j.spc.2022.06.024.

Gebhardt, M., Kopyto, M., Birkel, H. and Hartmann, E. (2022), “Industry 4.0 technologies as enablers of collaboration in circular supply chains: a systematic literature review”, *International Journal of Production Research*, Taylor & Francis, Vol. 60 No. 23, pp. 6967–6995, doi: 10.1080/00207543.2021.1999521.

Gong, Y., Jia, F., Brown, S. and Koh, L. (2018), “Supply chain learning of sustainability in multi-tier supply chains: A resource orchestration perspective”, *International Journal of Operations & Production Management*, Emerald Publishing Limited, Vol. 38 No. 4, pp. 1061–1090, doi: 10.1108/IJOPM-05-2017-0306.

Gong, Y., Jiang, Y. and Jia, F. (2023), “Multiple multi-tier sustainable supply chain management: a social system theory perspective”, *International Journal of Production Research*, Taylor & Francis, Vol. 61 No. 14, pp. 4684–4701, doi: 10.1080/00207543.2021.1930238.

Gong, Y., Jiang ,Yan and and Jia, F. (2023), “Multiple multi-tier sustainable supply chain management: a social system theory perspective”, *International Journal of Production Research*, Taylor & Francis, Vol. 61 No. 14, pp. 4684–4701, doi: 10.1080/00207543.2021.1930238.

Grimm, J., Langley, A. and Reinecke, J. (2024), “Process Research Methods for Studying Supply Chains and Their Management”, *Journal of Supply Chain Management*, Vol. 60 No. 4, pp. 3–26, doi: 10.1111/jscm.12331.

Grimm, J. and Reinecke, J. (2024), “Collaborating on the Edge of Failure: Frame Alignment across Multiple Interaction Arenas in Multi-Stakeholder Partnerships”, *Academy of Management Journal*, Vol. 67 No. 4, pp. 956–990, doi: 10.5465/amj.2021.0466.

Grimm, J.H., Hofstetter ,Joerg S. and and Sarkis, J. (2023), “Corporate sustainability standards in multi-tier supply chains – an institutional entrepreneurship perspective”, *International Journal of Production Research*, Taylor & Francis, Vol. 61 No. 14, pp. 4702–4724, doi: 10.1080/00207543.2021.2017053.

Grimm, J.H., Hofstetter, J.S. and Sarkis, J. (2016), “Exploring sub-suppliers’ compliance with corporate sustainability standards”, *Journal of Cleaner Production*, Vol. 112, pp. 1971–1984, doi: 10.1016/j.jclepro.2014.11.036.

Grimm, J.H., Hofstetter, J.S. and Sarkis, J. (2018), “Interrelationships amongst factors for sub-supplier corporate sustainability standards compliance: An exploratory field study”, *Journal of Cleaner Production*, Vol. 203, pp. 240–259, doi: 10.1016/j.jclepro.2018.08.074.

Grimm, J.H., Hofstetter, J.S. and Sarkis, J. (2023), “Corporate sustainability standards in multi-tier supply chains – an institutional entrepreneurship perspective”, *International*

Journal of Production Research, Taylor & Francis, Vol. 61 No. 14, pp. 4702–4724, doi: 10.1080/00207543.2021.2017053.

Halinen, A. and Törnroos, J.-Å. (2005), "Using case methods in the study of contemporary business networks", *Journal of Business Research*, Vol. 58 No. 9, pp. 1285–1297, doi: 10.1016/j.jbusres.2004.02.001.

Halldorsson, A., Kotzab, H., Mikkola, J.H. and Skjøtt-Larsen, T. (2007), "Complementary theories to supply chain management", *Supply Chain Management: An International Journal*, Emerald Group Publishing Limited, Vol. 12 No. 4, pp. 284–296, doi: 10.1108/13598540710759808.

Hazen, B.T., Russo, I., Confente, I. and Pellathy, D. (2020), "Supply chain management for circular economy: conceptual framework and research agenda", *The International Journal of Logistics Management*, Emerald Publishing Limited, Vol. 32 No. 2, pp. 510–537, doi: 10.1108/IJLM-12-2019-0332.

Heldt, L. and Beske-Janssen, P. (2023), "Solutions from space? A dynamic capabilities perspective on the growing use of satellite technology for managing sustainability in multi-tier supply chains", *International Journal of Production Economics*, Vol. 260, p. 108864, doi: 10.1016/j.ijpe.2023.108864.

Herbst, T.D. (2021), "Component suppliers in the commodity battle: Can digital technology in multi-tier supply chains help to transform liabilities into opportunities?", *International Journal of Business Science & Applied Management (IJBSAM)*, s.l.: International Journal of Business Science & Applied Management, Vol. 16 No. 2, pp. 22–45.

Heydari, J., Govindan, K. and Aslani, A. (2019), "Pricing and greening decisions in a three-tier dual channel supply chain", *International Journal of Production Economics*, Vol. 217, pp. 185–196, doi: 10.1016/j.ijpe.2018.11.012.

Hofstede, G. (2013), *Culture's Consequences: Comparing Values, Behaviors, Institutions, and Organizations across Nations*, 2. ed. [Nachdr.]., Sage, Thousand Oaks, Calif.

Hou, H., Ju, Y., Chen, L., Luo, Y. and Wang, Q. (2024), "Triple-A supply chain and firm performance relationship: a meta-analysis", *International Journal of Logistics Research and Applications*, Taylor & Francis, Vol. 27 No. 10, pp. 1742–1765, doi: 10.1080/13675567.2023.2179979.

Hyndman, K., Kraiselburd, S. and Watson, N. (2014), "Coordination in Games with Strategic Complementarities: An Experiment on Fixed vs. Random Matching", *Production and Operations Management*, Vol. 23 No. 2, pp. 221–238, doi: 10.1111/j.1937-5956.2012.01384.x.

Im, G., Rai, A. and Lambert, L.S. (2019), "Governance and Resource-Sharing Ambidexterity for Generating Relationship Benefits in Supply Chain Collaborations", *Decision Sciences*, Vol. 50 No. 4, pp. 656–693, doi: 10.1111/deci.12353.

Jamalnia, A., Gong, Y. and Govindan, K. (2023), "Sub-supplier's sustainability management in multi-tier supply chains: A systematic literature review on the contingency variables, and a conceptual framework", *International Journal of Production Economics*, Vol. 255, p. 108671, doi: 10.1016/j.ijpe.2022.108671.

Johns, G. (2006), "The Essential Impact of Context on Organizational Behavior", *Academy of Management Review*, Vol. 31 No. 2, pp. 386–408, doi: 10.5465/amr.2006.20208687.

Kähkönen, A.-K., Marttinen, K., Kontio, A. and Lintukangas, K. (2023), "Practices and strategies for sustainability-related risk management in multi-tier supply chains", *Journal of Purchasing and Supply Management*, Vol. 29 No. 3, p. 100848, doi: 10.1016/j.pursup.2023.100848.

Kauppi, K., Brandon-Jones, A., van Raaij, E.M. and Matinheikki, J. (2024), "'If only we'd known': Theory of supply failure under two-sided information asymmetry", *Journal of Supply Chain Management*, Vol. 60 No. 1, pp. 32–52, doi: 10.1111/jscm.12312.

Keller, A., Lumineau, F., Mellewigt, T. and Ariño, A. (2021), "Alliance Governance Mechanisms in the Face of Disruption", *Organization Science*, Vol. 32 No. 6, pp. 1542–1570, doi: 10.1287/orsc.2021.1437.

Kembro, J., Näslund, D. and Olhager, J. (2025), "Information sharing in extended supply chains: why does it have to be so difficult?", *Production Planning & Control*, Taylor & Francis, Vol. 36 No. 8, pp. 1029–1043, doi: 10.1080/09537287.2024.2331742.

Ketokivi, M. and Choi, T. (2014), "Renaissance of case research as a scientific method", *Journal of Operations Management*, Vol. 32 No. 5, pp. 232–240, doi: 10.1016/j.jom.2014.03.004.

Kirchherr, J., Reike, D. and Hekkert, M. (2017), "Conceptualizing the circular economy: An analysis of 114 definitions", *Resources, Conservation and Recycling*, Vol. 127, pp. 221–232, doi: 10.1016/j.resconrec.2017.09.005.

Kocabasoglu-Hillmer, C., Vanpoucke, E., Son, B.-G. and Roden, S. (2023), "Seeing with fresh eyes – the potential of paradox theory to explore persistent, interdependent tensions in supply chains", *International Journal of Operations & Production Management*, Vol. 43 No. 11, pp. 1669–1689, doi: 10.1108/IJOPM-07-2023-0605.

Köhler, J., Sönnichsen, S.D. and Beske-Jansen, P. (2022), "Towards a collaboration framework for circular economy: The role of dynamic capabilities and open innovation", *Business Strategy and the Environment*, Vol. 31 No. 6, pp. 2700–2713, doi: 10.1002/bse.3000.

Kumar, A., Steven, A. and Paraskevas, J.-P. (2020), "Impact of buyer-supplier TMT misalignment on environmental performance", *International Journal of Operations & Production Management*, Emerald Publishing Limited, Vol. 40 No. 11, pp. 1695–1721, doi: 10.1108/IJOPM-01-2020-0046.

Kusi-Sarpong, S., Gong, Y. (Jack), Brown, S., Gupta, H., Bai, C. and Orji, I.J. (2023), "Multi-tier sustainable supply chains management for global sustainability", *International Journal of Production Research*, Taylor & Francis, Vol. 61 No. 14, pp. 4592–4602, doi: 10.1080/00207543.2023.2216831.

Langley, A. (1999), "Strategies for Theorizing from Process Data", *The Academy of Management Review*, Vol. 24 No. 4, p. 691, doi: 10.2307/259349.

Langley, A., Smallman, C., Tsoukas, H. and Van De Ven, A.H. (2013), "Process Studies of Change in Organization and Management: Unveiling Temporality, Activity, and Flow", *Academy of Management Journal*, Vol. 56 No. 1, pp. 1–13, doi: 10.5465/amj.2013.4001.

Langley Ann. (1999), "Strategies for Theorizing from Process data", *The Academy of Management Review*, Vol. 24 No. 4, pp. 691–710.

Lechler, S., Canzaniello, A. and Hartmann, E. (2019), "Assessment sharing intra-industry strategic alliances: Effects on sustainable supplier management within multi-tier supply chains", *International Journal of Production Economics*, Vol. 217, pp. 64–77, doi: 10.1016/j.ijpe.2019.01.005.

Lee, H.L. (2004), "The Triple-A Supply Chain", *Harvard Business Review*, Vol. 82 No. 10, pp. 102–113.

Lincoln, Y.S. and Guba, E.G. (1985), *Naturalistic Inquiry*, Sage Publications, Beverly Hills, Calif.

Ludwikowski, M. and Sjoberg, W. (2021), "Semiconductor shortage and the U.S. auto industry", Reuters, 22 June.

Lundin, J.F. and Norrman, A. (2010), “The misalignment cycle: is the management of your supply chain aligned?”, edited by Hertz, S., Hultman, J. and Wikner, J.*International Journal of Physical Distribution & Logistics Management*, Emerald Group Publishing Limited, Vol. 40 No. 4, pp. 277–297, doi: 10.1108/09600031011045307.

Luthra, S., Sharma, M., Kumar, A., Joshi, S., Collins, E. and Mangla, S. (2022), “Overcoming barriers to cross-sector collaboration in circular supply chain management: a multi-method approach”, *Transportation Research Part E: Logistics and Transportation Review*, Vol. 157, p. 102582, doi: 10.1016/j.tre.2021.102582.

Lyons, A.C. and Ma’aram, A. (2014), “An examination of multi-tier supply chain strategy alignment in the food industry”, *International Journal of Production Research*, Taylor & Francis, Vol. 52 No. 7, pp. 1911–1925, doi: 10.1080/00207543.2013.787172.

M. Tachizawa, E. and Yew Wong, C. (2014), “Towards a theory of multi-tier sustainable supply chains: a systematic literature review”, *Supply Chain Management: An International Journal*, Emerald Group Publishing Limited, Vol. 19 No. 5/6, pp. 643–663, doi: 10.1108/SCM-02-2014-0070.

Martinez-Olvera, C. (2010), “Impact of the alignment between the strategic and operational levels of a manufacturing enterprise”, *International Journal of Production Research*, Taylor & Francis, Vol. 48 No. 4, pp. 1195–1215, doi: 10.1080/00207540802534723.

Marttinen, K. and Kähkönen, A.-K. (2022), “Fostering firms’ ability to cascade sustainability through multi-tier supply chains: an investigation of power sources”, *International Journal of Operations & Production Management*, Emerald Publishing Limited, Vol. 42 No. 8, pp. 1146–1172, doi: 10.1108/IJOPM-11-2021-0739.

Maxwell, J.A. (2012), *A Realist Approach for Qualitative Research*, Sage, Thousand Oaks, CA London Neu Delhi Singapur.

McAdam, R., Hazlett, S.-A. and Galbraith, B. (2014), “The role of performance measurement models in multi level alignment”, *International Journal of Operations & Production Management*, Emerald Group Publishing Limited, Vol. 34 No. 9, pp. 1153–1183, doi: 10.1108/IJOPM-09-2011-0313.

Mena, C., Humphries, A. and Choi, T.Y. (2013), “Toward a Theory of Multi-Tier Supply Chain Management”, *Journal of Supply Chain Management*, Vol. 49 No. 2, pp. 58–77, doi: 10.1111/jscm.12003.

Mena, C. and and Schoenherr, T. (2023), “The green contagion effect: an investigation into the propagation of environmental practices across multiple supply chains tiers”, *International Journal of Production Research*, Taylor & Francis, Vol. 61 No. 14, pp. 4808–4825, doi: 10.1080/00207543.2020.1834160.

Meredith, J. (1998), “Building operations management theory through case and field research”, *Journal of Operations Management*, Vol. 16 No. 4, pp. 441–454, doi: 10.1016/S0272-6963(98)00023-0.

Miles, M.B., Huberman, A.M. and Saldaña, J. (2014), *Qualitative Data Analysis: A Methods Sourcebook*, Third edition., SAGE Publications, Inc., Thousand Oaks, Californinia.

Mönch, L., Uzsoy, R. and Fowler, J.W. (2018), “A survey of semiconductor supply chain models part I: semiconductor supply chains, strategic network design, and supply chain simulation”, *International Journal of Production Research*, Taylor & Francis, Vol. 56 No. 13, pp. 4524–4545, doi: 10.1080/00207543.2017.1401233.

Najjar, M. and Yasin, M.M. (2023), “The management of global multi-tier sustainable supply chains: a complexity theory perspective”, *International Journal of Production*

Research, Taylor & Francis, Vol. 61 No. 14, pp. 4853–4870, doi: 10.1080/00207543.2021.1990432.

Narayanan, V. g. and Raman, A. (2004), "Aligning Incentives in Supply Chains", *Harvard Business Review*, Harvard Business School Publication Corp., Vol. 82 No. 11, pp. 94–102.

Nellis, S. (2021), "TSMC looks to double down on U.S. chip factories as talks in Europe falter", Reuters, 14 May.

Norrman, A. and Naslund, D. (2019), "Supply Chain Incentive Alignment: The Gap between Perceived Importance and Actual Practice", *Operations and Supply Chain Management: An International Journal*, pp. 129–142, doi: 10.31387/oscm0380237.

Oliva, R. and Watson, N. (2009), "Managing Functional Biases in Organizational Forecasts: A Case Study of Consensus Forecasting in Supply Chain Planning", *Production and Operations Management*, SAGE Publications, Vol. 18 No. 2, pp. 138–151, doi: 10.1111/j.1937-5956.2009.01003.x.

Oyedijo, A., Kusi-Sarpong, S., Mubarik, M.S., Khan, S.A. and Utulu, K. (2023), "Multi-tier sustainable supply chain management: a case study of a global food retailer", *Supply Chain Management: An International Journal*, Emerald Publishing Limited, Vol. 29 No. 1, pp. 68–97, doi: 10.1108/SCM-05-2022-0205.

Patrucco, A., Harland, C.M., Luzzini, D. and Frattini, F. (2022), "Managing triadic supplier relationships in collaborative innovation projects: a relational view perspective", *Supply Chain Management: An International Journal*, Emerald Publishing Limited, Vol. 27 No. 7, pp. 108–127, doi: 10.1108/SCM-05-2021-0220.

Patton, M.Q. (2015), *Qualitative Research & Evaluation Methods: Integrating Theory and Practice*, Fourth edition., SAGE Publications, Inc, Thousand Oaks, California.

Pettigrew, A.M. (1990), "Longitudinal Field Research on Change: Theory and Practice", *Organization Science*, Vol. 1 No. 3, pp. 267–292, doi: 10.1287/orsc.1.3.267.

Pettit, T.J., Fiksel, J. and Croxton, K.L. (2010), "Ensuring Supply Chain Resilience: Development of a Conceptual Framework", *Journal of Business Logistics*, Vol. 31 No. 1, pp. 1–21, doi: 10.1002/j.2158-1592.2010.tb00125.x.

Piplani, R. and Fu, Y. (2005), "A coordination framework for supply chain inventory alignment", *Journal of Manufacturing Technology Management*, Emerald Group Publishing Limited, Vol. 16 No. 6, pp. 598–614, doi: 10.1108/17410380510609465.

Placek, M. (2023), *Automotive Electronics Cost as a Share of Total Car Cost 1970-2030*, Statista.

Poppo, L. and Zenger, T. (2002), "Do formal contracts and relational governance function as substitutes or complements?", *Strategic Management Journal*, Vol. 23 No. 8, pp. 707–725, doi: 10.1002/smj.249.

Putnam, L.L., Fairhurst, G.T. and Banghart, S. (2016), "Contradictions, Dialectics, and Paradoxes in Organizations: A Constitutive Approach", *Academy of Management Annals*, Academy of Management, Vol. 10 No. 1, pp. 65–171, doi: 10.5465/19416520.2016.1162421.

Reichhart, A. and Holweg, M. (2008), "Co-located supplier clusters: forms, functions and theoretical perspectives", *International Journal of Operations & Production Management*, Emerald Group Publishing Limited, Vol. 28 No. 1, pp. 53–78, doi: 10.1108/01443570810841103.

Reusen, E. and Stouthuysen, K. (2017), "Misaligned control: The role of management control system imitation in supply chains", *Accounting, Organizations and Society*, Vol. 61, pp. 22–35, doi: 10.1016/j.aos.2017.08.001.

Roehrich, J.K., Selviaridis, K., Kalra, J., Van der Valk, W. and Fang, F. (2020), "Inter-organizational governance: a review, conceptualisation and extension", *Production*

Planning & Control, Taylor & Francis, Vol. 31 No. 6, pp. 453–469, doi: 10.1080/09537287.2019.1647364.
Saldaña, J. (2021), "Coding Techniques for Quantitative and Mixed Data", *The Routledge Reviewer's Guide to Mixed Methods Analysis*, Routledge.
Sarja, M., Mäkelä, M., Onkila, T., Koistinen, K., Teerikangas, S. and Valkjärvi, M. (2025), "All for One and One for All: Inter-Firm Collaboration in the Transformation Towards a Circular Economy", *Sustainable Development*, Vol. n/a, doi: 10.1002/sd.70020.
Sayer, A. (Ed.). (2010), *Realism and Social Science*, Sage, London Thousand Oaks, Calif.
Selviaridis, K. and Spring, M. (2018), "Supply chain alignment as process: contracting, learning and pay-for-performance", *International Journal of Operations & Production Management*, Vol. 38 No. 3, pp. 732–755, doi: 10.1108/IJOPM-01-2017-0059.
Selviaridis, K. and Wynstra, F. (2015), "Performance-based contracting: a literature review and future research directions", *International Journal of Production Research*, Vol. 53 No. 12, pp. 3505–3540, doi: 10.1080/00207543.2014.978031.
Skipworth, H., Godsell, J., Wong, C.Y., Saghiri, S. and Julien, D. (2015), "Supply chain alignment for improved business performance: an empirical study", *Supply Chain Management: An International Journal*, Vol. 20 No. 5, pp. 511–533, doi: 10.1108/SCM-06-2014-0188.
Smith, W.K. and Lewis, M.W. (2011), "Toward a Theory of Paradox: A Dynamic equilibrium Model of Organizing", *Academy of Management Review*, Vol. 36 No. 2, pp. 381–403, doi: 10.5465/amr.2009.0223.
Soosay, C.A. and Hyland, P. (2015), "A decade of supply chain collaboration and directions for future research", *Supply Chain Management: An International Journal*, Vol. 20 No. 6, pp. 613–630, doi: 10.1108/SCM-06-2015-0217.
Statsenko, L., Scholten, K. and Stevenson, M. (2025), "The influence of global value chain governance on supply network resilience", *Supply Chain Management: An International Journal*, doi: 10.1108/SCM-05-2024-0328.
Sternberg, H., Mathauer, M. and Hofmann, E. (2023), "Technology management in multi-tier chains: A case study of agency in logistics service outsourcing", *Journal of Operations Management*, Vol. 69 No. 4, pp. 536–557, doi: 10.1002/joom.1219.
Sudusinghe, J.I. and Seuring, S. (2022), "Supply chain collaboration and sustainability performance in circular economy: A systematic literature review", *International Journal of Production Economics*, Vol. 245, p. 108402, doi: 10.1016/j.ijpe.2021.108402.
Swierczek, A. (2024), "Driven by supply chain ambidexterity. Substitutable and complementary effects of supply chain emergence and control on triadic relational performance", *Journal of Purchasing and Supply Management*, Vol. 30 No. 1, p. 100894, doi: 10.1016/j.pursup.2023.100894.
Swierczek, A. and Szozda, N. (2023), "The impact of dyadic relationships in supply chain triads", *International Journal of Operations & Production Management*, Emerald Publishing Limited, Vol. 44 No. 1, pp. 155–178, doi: 10.1108/IJOPM-10-2022-0677.
Tuni, A. and Rentizelas, A. (2019), "An innovative eco-intensity based method for assessing extended supply chain environmental sustainability", *International Journal of Production Economics*, Vol. 217, pp. 126–142, doi: 10.1016/j.ijpe.2018.08.028.
Vachon, S., Halley, A. and Beaulieu, M. (2009), "Aligning competitive priorities in the supply chain: the role of interactions with suppliers", *International Journal of Operations & Production Management*, Vol. 29 No. 4, pp. 322–340, doi: 10.1108/01443570910945800.

Van Hoek, R.I. and Mitchell, A.J. (2006), "The challenge of internal misalignment", *International Journal of Logistics Research and Applications*, Taylor & Francis, Vol. 9 No. 3, pp. 269–281, doi: 10.1080/13675560600859342.
Van Opstal, W., Smeets, A. and Pals, E. (2024), "Aligning incentives for implementing reversible bonding as a circular economy innovation", *Business Strategy and the Environment*, Vol. 33 No. 8, pp. 8017–8036, doi: 10.1002/bse.3904.
Veleva, V. and Bodkin, G. (2018), "Corporate-entrepreneur collaborations to advance a circular economy", *Journal of Cleaner Production*, Vol. 188, pp. 20–37, doi: 10.1016/j.jclepro.2018.03.196.
van de Ven, A.H. and Poole, M.S. (1995), "Explaining Development and Change in Organizations", *The Academy of Management Review*, Academy of Management, Vol. 20 No. 3, pp. 510–540, doi: 10.2307/258786.
Villena, V.H. and Gioia, D.A. (2018), "On the riskiness of lower-tier suppliers: Managing sustainability in supply networks", *Journal of Operations Management*, Vol. 64 No. 1, pp. 65–87, doi: 10.1016/j.jom.2018.09.004.
Villena, V.H., Revilla, E. and Choi, T.Y. (2011), "The dark side of buyer–supplier relationships: A social capital perspective", *Journal of Operations Management*, Vol. 29 No. 6, pp. 561–576, doi: 10.1016/j.jom.2010.09.001.
Voss, C. (2008), "Case Research in Operations Management", *Researching Operations Management*, Routledge.
Wieland, A. (2021), "Dancing the Supply Chain: Toward Transformative Supply Chain Management", *Journal of Supply Chain Management*, Vol. 57 No. 1, pp. 58–73, doi: 10.1111/jscm.12248.
Wiles, R., Crow, G., Heath, S. and Charles, V. (2008), "The Management of Confidentiality and Anonymity in Social Research", *International Journal of Social Research Methodology*, Vol. 11 No. 5, pp. 417–428, doi: 10.1080/13645570701622231.
Wilhelm, M.M., Blome, C., Bhakoo, V. and Paulraj, A. (2016), "Sustainability in multi-tier supply chains: Understanding the double agency role of the first-tier supplier", *Journal of Operations Management*, Vol. 41 No. 1, pp. 42–60, doi: 10.1016/j.jom.2015.11.001.
Wong, C., Skipworth, H., Godsell, J. and Achimugu, N. (2012), "Towards a theory of supply chain alignment enablers: a systematic literature review", edited by Wilding, R.*Supply Chain Management: An International Journal*, Vol. 17 No. 4, pp. 419–437, doi: 10.1108/13598541211246567.
Wong, C.W.Y., Lai, K.H. and Cheng, T.C.E. (2009), "Complementarities and alignment of information systems management and supply chain management", *International Journal of Shipping and Transport Logistics*, Vol. 1 No. 2, p. 156, doi: 10.1504/IJSTL.2009.024493.
Wu, X., Kouvelis, P., Matsuo, H. and Sano, H. (2014), "Horizontal coordinating contracts in the semiconductor industry", *European Journal of Operational Research*, Vol. 237 No. 3, pp. 887–897, doi: 10.1016/j.ejor.2014.02.050.
Xiong, W., Wu, D.D. and Yeung, J.H.Y. (2025), "Semiconductor supply chain resilience and disruption: insights, mitigation, and future directions", *International Journal of Production Research*, Taylor & Francis, Vol. 63 No. 9, pp. 3442–3465, doi: 10.1080/00207543.2024.2387074.
Yang, Y.S., Choi, T.Y., Carter, C.R. and Yin, R. (2022), "Expanding the boundaries of buyer-supplier agency problems: Moving from dyad to triad", *Journal of Purchasing and Supply Management*, Vol. 28 No. 3, p. 100749, doi: 10.1016/j.pursup.2022.100749.

Yang, Z., Wu, M., Sun, J. and Zhang, Y. (2024), “Aligning redundancy and flexibility for supply chain resilience: a literature synthesis”, *Journal of Risk Research*, Routledge, Vol. 27 No. 2, pp. 313–335, doi: 10.1080/13669877.2024.2328196.

Yin, R.K. (2018), *Case Study Research and Applications: Design and Methods*, Sixth edition., SAGE, Los Angeles London New Delhi Singapore Washington DC Melbourne.

Zapp, M., Forster, C., Verl, A. and Bauernhansl, T. (2012), “A Reference Model for Collaborative Capacity Planning Between Automotive and Semiconductor Industry”, *Procedia CIRP*, Vol. 3, pp. 155–160, doi: 10.1016/j.procir.2012.07.028.

Zehendner, A.G., Sauer, P.C., Schöpflin, P., Kähkönen, A.-K. and Seuring, S. (2021), “Paradoxical tensions in sustainable supply chain management: insights from the electronics multi-tier supply chain context”, *International Journal of Operations & Production Management*, Vol. 41 No. 6, pp. 882–907, doi: 10.1108/IJOPM-10-2020-0709.

Zhu, C., Guo, X. and Zou, S. (2022), “Impact of information and communications technology alignment on supply chain performance in the Industry 4.0 era: mediation effect of supply chain integration”, *Journal of Industrial and Production Engineering*, Vol. 39 No. 7, pp. 505–520, doi: 10.1080/21681015.2022.2099472.

Zhu, H., Hu, J. and Yang, Y. (2025), “Towards a circular supply chain for retired electric vehicle batteries: A systematic literature review”, *International Journal of Production Economics*, Vol. 282, p. 109556, doi: 10.1016/j.ijpe.2025.109556.

Zils, M., Howard, M. and Hopkinson, P. (2025), “Circular economy implementation in operations & supply chain management: Building a pathway to business transformation”, *Production Planning & Control*, Taylor & Francis, Vol. 36 No. 4, pp. 501–520, doi: 10.1080/09537287.2023.2280907.