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Multi-Level Perspectives on Supply Chain Emissions Reduction: Three Essays on Triadic Supply Chain Structures, Alignment Mechanisms, and Paradoxical Cognition

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ABSTRACT

Supply chains' environmental impact is now, more than ever, in the spotlight. Policymakers are pressuring businesses to address emissions coming from their own direct operations and power consumption, as well as those generated in their extended supply chains. The topic is also capturing the attention of supply chain management scholars, a field where academic research still lags behind practice, thus sparking diverse calls for more research. This dissertation rests on the recognition of the critical role played by the numerous and sparse actors in supply chains in tackling climate change, and investigates relational and alignment dynamics among actors in a triad, as well as organizational characteristics that allow achieving supply chain emission reduction goals. To address the topic, this dissertation employs a multi-method design approach, complementing a systematic literature review of 128 research papers from top logistics and supply chain journals with exploratory, qualitative research that builds on interviews collected from Italian businesses. The first essay systematically reviews existing logistics and supply chain management literature to understand how it has incorporated inter-organizational triads, motivated by the potential for a triad to offer insights into broader supply chain relational dynamics. The review highlights gaps related to sustainability, despite large evidence that shows that the vast majority of the environmental impact of a firm is not under its direct control, but rather it is concentrated in its supply chain. Thus, it sets the stage for the following empirical essays that adopt a multi-level approach. Essay 2 uses interviews collected from three firms in the household appliances sector to empirically investigate relational dynamics and interactions among actors in a logistics triad. The second essay extends the scope to further levels of analysis (i.e., functional and organizational) and finds that actors find alignment more easily when environmental initiatives deliver simultaneous benefits in terms of efficiency or cost advantages. Instead, when regulatory signals are ambiguous or external customer pressure is not matched by collaborative development or strategic prioritization, misalignment emerges, slowing implementation of initiatives. Essay 3 further frames the conditions that hinder alignment as tensions and analyzes how organizations that are effective in reducing their emissions look like, internally and throughout their supply chain, as these are the organizations that are equipped to also address the intrinsic competing tensions surrounding supply chain emissions reduction. The study adds a cognitive account and extends some aspects of paradox theory, highlighting how individuals within organizations cope with paradoxical tensions and how organizational elements influence their sensemaking. Overall, this dissertation intends to provide new insights into a critical research field, advancing theory and practice.

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I. INTRODUCTION

Motivation and relevance of the research topic

This dissertation addresses the supply chain emissions discourse, a topic inspired by both a personal interest and a research project I jumped on early in my research journey. While attention to climate change and greenhouse gas (GHG) emissions was mounting, with policymakers around the world setting reduction targets and reporting obligations, I was starting an industrial PhD program in supply chain management with a scholarship funded by a manufacturing firm in the household appliances sector. The need to tackle GHG emissions emerged early in the initial discourses with managers at the firm, who were moved by their customers' sensitivity and demands on environmental sustainability issues, as well as pushed by regulatory pressure and market expectations. Together with contextual factors, conversations with managers helped me realize the critical role played by the numerous and sparse actors in supply chains in tackling climate change and the opportunities of this research stream. Furthermore, suggestions by my supervisors inspired me to delve further into this emerging stream of research. Thus, I was motivated to pursue the investigation of how companies can (and need to) involve actors in their supply chain processes and initiatives to make an impact in the realm of emissions reduction. As I explored various methodologies and participated in doctoral seminars, exposure to qualitative methods motivated a research design that allows exploring new and complex phenomena, building on the richness of in-depth interviews.

The relevance of this research is grounded in supply chain management literature, managerial practices, and current policies, further highlighting its importance in addressing contemporary industry challenges. First, the shift from firm-level to supply chain-level competition has been well documented in the literature, with global sourcing, outsourcing, and process fragmentation creating extended chains of interdependence (Mena et al., 2013; Rosca et al., 2022). A research approach that moves beyond dyadic views of supply chains to embrace a broader perspective was inspired by an early suggestion in the doctoral journey. Scholars in the field have argued that insights into supply chain-level phenomena require at least three actors in view - i.e., a triad - since dyadic designs systematically miss how one relationship affects another and how positions and roles shape behaviors across links (Choi & Wu, 2009a, 2009b; Vedel et al., 2016). Triads thus represent the smallest configuration that can capture node-to-node influences, and they serve as a gateway to understanding and theorizing broader supply chain dynamics and behaviors (Bastl et al., 2013; Fletcher-Chen et al., 2022; Prataviera et al., 2023).

Second, climate change has become a defining challenge for supply chains and reinforces the need for an extended approach to investigation and theorizing. Indeed, the majority of corporate

environmental impacts in terms of carbon footprint reside in indirect (Scope 3) emissions upstream and downstream of the focal firm (CarbonTrust, 2023; Dahlmann et al., 2023; GHG Protocol, 2024). Therefore, impactful initiatives for emissions reduction necessarily require not only engaging functions within the whole organization, but also engaging actors in the supply chain to enable inter-organizational coordination, data exchange, as well as the engagement and alignment of goals among actors in the supply chain (Canal Vieira et al., 2026; De Stefano & Montes-Sancho, 2023; Ellram & Tate, 2025). Yet, despite an increasing number of climate pledges, organizations still struggle to translate strategic and regulatory ambitions into operational routines across functions and partners, running into trade-offs and competing demands among cost, service, environmental performance, and technical peculiarities (Björklund et al., 2024; Huge-Brodin et al., 2020; Matos et al., 2020). This makes supply chain emissions reduction a fertile setting for exploratory research, as confirmed by the recent recognition this stream has gained, from both academics and practitioners, highlighting its growing strategic importance (Ellram & Tate, 2025; Wieland & Creutzig, 2025; Zhang et al., 2024).

A shift from an organizational focus on corporate sustainability towards sustainable supply chain management and supply chain emissions has also become a key focus in industry practice and policymaking. Companies such as Apple and Amazon have publicly declared their goal of becoming carbon neutral or "net zero" in the near future, and are recognizing that substantial potential for reducing global GHG emissions lies in the hands of chief supply chain officers (Apple, 2024; Wieland & Creutzig, 2025). In a dynamic landscape characterized by technological innovation and changing regulations, companies are presented with both pressing challenges and promising opportunities, as supported by a growing body of consultancy reports and press articles addressing transportation and logistics, procurement, reporting, and data availability (e.g., CDP, 2021; McKinsey, 2024; Velázquez Martínez et al., 2025). The report published by the World Economic Forum, in collaboration with Boston Consulting Group, titled "Net-Zero Challenge: The supply chain opportunity" (World Economic Forum, 2021) further highlighted this trend, noting that by addressing supply-chain emissions many customer-facing companies can impact a volume of emissions several times higher than they could if they were to focus on decarbonizing their own direct operations and power consumption alone.

From a policymaking and regulatory perspective, supply chains are now more than ever under the spotlight. Policymakers worldwide, along with advocacy groups like the United Nations Sustainable Development Goals and the Science Based Targets initiative, are actively working to reduce emissions and the effects of climate change (IPCC, 2018; Wieland & Creutzig, 2025). The Paris Agreement on Climate Change was adopted by 195 parties globally and aims at limiting global warming to well below 2°C relative to pre-industrial levels, to avoid far more severe climate change

impacts. The Corporate Sustainability Reporting Directive (CSRD), issued by the European Commission, is pushing companies to standardize disclosures and improve data governance throughout their supply chains: this regulatory framework directly affects European businesses and indirectly affects non-EU multinationals through subsidiaries, listings, and supply-chain expectations (European Commission, 2023; Velázquez Martínez et al., 2025). As contextual factors keep evolving and scientific studies increasingly warn of misalignments between current emissions reduction trajectories and targets (Cenci et al., 2023), research on relational dynamics among actors in the supply chain and organizational characteristics that allow achieving emission reduction goals becomes increasingly relevant.

Two key research areas emerge as critical within the supply chain management literature for the development of this dissertation. One of the key areas is the need for a multi-level approach to the investigation of supply chain emission reduction strategies, to include intra-organizational (i.e., functional-level) as well as inter-organizational (i.e., supply chain-level) alignment. As managers and actors act to respond to frequently competing demand – where the reduction of environmental impact represents one goal among others - ensuring alignment in KPIs, reporting standards, and incentives within the organization and across the entire supply chain has gained importance but remains a difficult goal for businesses to achieve (Ellram & Tate, 2025; Huge-Brodin et al., 2020). Additionally, competing demands can be framed as paradoxes, which may paralyze progress if not properly managed (Cichosz et al., 2025; Xiao et al., 2019). Understanding which factors enable individual managers to make sense of paradoxes, thus allowing organizations to proactively face the paradoxical tensions that are intrinsic to sustainable supply chain management, can explain slow progress in emissions reductions and highlight areas for intervention. Accordingly, this dissertation focuses on supply chain emissions, with an emphasis on multi-level organizational dynamics.

Scope and structure of the dissertation

This dissertation comprises three independent essays, constituting the three assignments delivered at the end of each year of the doctoral program, submitted respectively in January 2024, November 2024, and October 2025. While these essays are self-contained, when read sequentially, they offer a comprehensive exploration of the research topic. Figure 1 illustrates the timeline and progression of these three essays in the doctoral pathway, highlighting the research methods, theoretical foundations employed, and primary focus of each analysis. The essays were developed sequentially, driven by a common interest in the supply chain emissions discourse, both personal and from the funding firm. The research focus was then refined by insights gained along the way, moving from the investigation of GHG emissions broadly defined (i.e., Scope 1, Scope 2, and Scope 3,

according to the GHG Protocol), to a more precise focus on supply chain GHG emissions (i.e., Scope 3). This shift was supported by the recognition, from industry practice and academic literature, of a long-needed broader approach that required considering relational dynamics beyond a single organization. The first essay, a systematic literature review, offered a deep investigation of triadic studies in the supply chain management literature, which was useful to identify, among others, inter-organizational dynamics and investigated topics. The findings helped draw key avenues for future research and inspired the development of the second essay. Sequentially, the third essay builds on the outcomes and the discussions in essay 2, reflecting the progressive evolution of the research. The three essays have been presented at various academic conferences (i.e., SIMA conference, SIM conference, ERS CSCMP conference) either as research ideas or works in progress. Moreover, the second essay has been presented at the *Journal of Supply Chain Management Paper Development Workshop*.

The first essay examines how the existing logistics and supply chain management literature has incorporated inter-organizational triads – i.e., structures formed by three directly or indirectly associated actors (Vedel et al., 2016). It presents a systematic literature review of a sample of 128 articles published in leading logistics and supply chain management journals. The systematic literature review catalogued triadic structures investigated in the literature and mapped key themes, theories, and methods employed in the research domain. Lastly, the review highlights gaps related to sustainability investigation, motivating the following empirical essays.

The second essay focuses on the interplay of different levels that characterize supply chain management phenomena, namely functional, organizational and supply chain to understand how they combine and integrate in a company's pursuit of reducing emissions along the supply chain. The qualitative study adopts a grounded theory design to investigate a logistics triad formed by a retailer, an OEM manufacturer, and a logistics service provider; the triad serves as a proxy and enables to expand the scope of investigation to supply chain inter-organizational dynamics. The study draws on alignment theory and finds that alignment serves as a mechanism to move from commitments to outcomes. Specifically, alignment should stand between organizational stances on emissions reduction and day-to-day functional activities, as well as extend across supply-chain partners. The study reveals that alignment is strongest when environmental objectives coincide with cost/efficiency improvements; conversely, regulatory ambiguity and customer-only pressures, absent internal prioritization, generate misalignment and resource frictions, thus compromising environmental performance.

Finally, the third essay is a qualitative single-firm case in the beauty and cosmetics sector. The study draws on paradox theory and frames paradoxical tensions as intrinsic in sustainable supply

chain management (Smith & Lewis, 2011; Lewis & Smith, 2022). It shows how organizational factors (namely, leadership commitment, resource allocation, and decision guidelines grounded in objective measurement) create an organizational setting that fosters paradoxical cognitive frames among managers. In turn, managers reframe tensions between economic performance, service, and environmental goals as technical and/or design challenges that form part of their job. With this cognitive frame, managers propagate these frames beyond the firm, enhancing supplier engagement and positive spillovers. The essay articulates propositions linking organizational factors and managerial cognition to emissions outcomes and supplier behaviors, thereby adding micro-foundations to sustainable supply chain management.

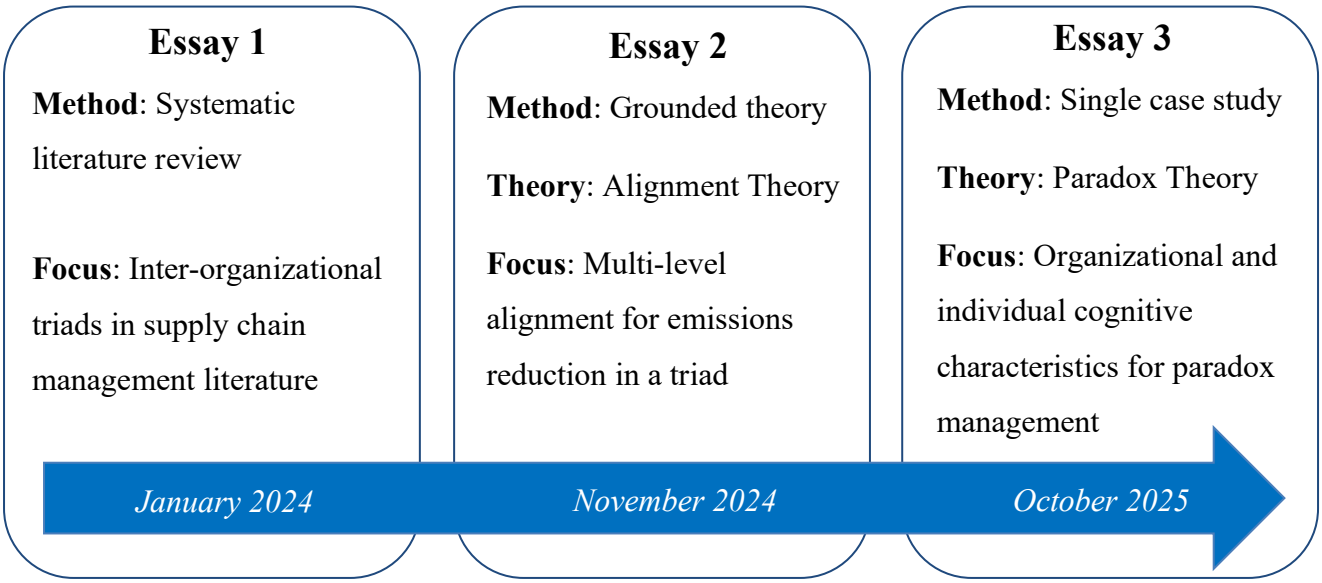

Figure 1. *Summary and timeline of the three essays*

Positioning the essays in the literature

The three essays of this dissertation are grounded on a literature review of inter-organizational relational dynamics, which revealed fruitful research avenues at the crossroad with the body of research in sustainable supply chain management. Within that, the topic of supply chain GHG emissions represents the fil rouge of the dissertation and is assessed considering different levels of analysis. To improve the flow of the three essays, each relevant body of literature is reported within each respective essay. While this approach may result in some overlap in the literature discussions, these repetitions are intentional and necessary to clearly establish the research background specific to each essay. In this section, I direct the reader with respect to the positioning of each essay within the body of literature and the flow connecting the three essays.

Across the three essays, the dissertation proceeds from a synthesis of inter-organizational triadic supply chain management scholarship (Essay 1), to an explanation of multi-level alignment mechanisms in a triad in the context of supply chain emissions reduction (Essay 2), to a micro-foundational account of how managerial cognition and organizational context enable management responses to sustainability tensions (Essay 3). The sequencing reflects cumulative learning from the literature and empirical work, and the intent to link supply chain structure, organizational processes, and individual cognition towards supply chain decarbonization.

The growing interest in the academic literature (Ellram & Tate, 2025; Villena & Dhanorkar, 2020; Wieland & Creutzig, 2025; Wilhelm & Villena, 2021), coupled with increasing business commitments and policymaking efforts that recognize the critical role played by the numerous and sparse actors in supply chains in tackling climate change, motivated and supported the necessity for a comprehensive review on inter-organizational triadic studies in supply chain management literature. The systematic analysis led to the identification of the main structures, theories, research methods, and topics characterizing this literature, thus guiding some directions for future research. Among the promising avenues for future research, opportunities have emerged around sustainable supply chain management and environmental impact issues. Counterintuitively, despite large evidence that shows that the vast majority of the carbon footprint of a firm is not under its direct control, rather it is concentrated in its supply chain (Carter et al., 2019; GHG Protocol, 2024), scant research has studied the topic going beyond the firm or dyadic perspective. A triad represents the minimum unit of analysis that can offer insights into network dynamics; thus, it can further the understanding of how to achieve supply chain emissions reduction objectives. This insight shaped the direction of the second essay, which empirically investigates relational dynamics and interactions among actors in a triad in the logistics context (namely, a logistics triad) (Larson & Gammelgaard, 2001) and extends the scope to further levels of analysis (i.e., functional and organizational). This study aims at understanding how functional routines, organizational priorities, and inter-firm collaboration jointly shape supply chain emissions outcomes. Building on the findings of the first empirical study, the third essay (i.e., second empirical study) moves to analyze how organizations that are effective in reducing their emissions look like, internally and throughout their supply chain, as these are the organizations that are equipped to also address the intrinsic competing tensions surrounding supply chain emissions reduction. Specifically, the essay investigates individual managerial characteristics and organizational factors that foster management responses to tensions.

The first essay looks at the supply chain level, assessing inter-organizational triadic relationships in supply chain management literature. The literature presented and discussed in the second essay has some minor overlaps and repetitions, as Essay 2 adopts a multi-level approach,

incorporating the supply chain level of analysis and pairing it with organizational and functional ones, to investigate their interplay towards GHG emissions reduction. Finally, the third study moves to an individual level of research to investigate managerial cognitive frames and how different individuals make sense of and respond to paradoxical tensions. Figure 2 builds on the conceptualization by Carter et al. (2015), which displays different levels of theory and analysis that characterize supply chain management phenomena. Accordingly, I position each of the three essays based on the level(s) of analysis it considers; overlapping of the squares indicates that one level of analysis is considered in more than one essay.

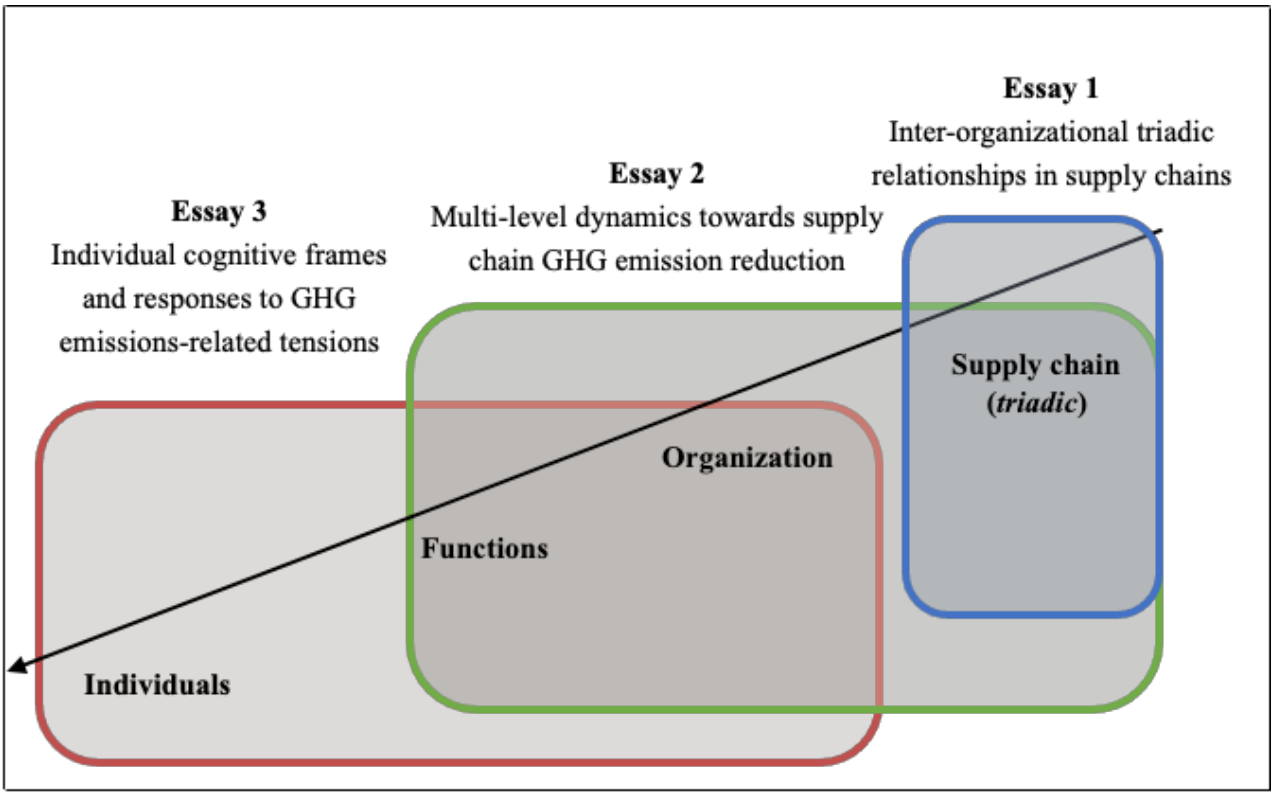

Figure 2. *Positioning of the essays in the literature*

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II. ESSAY 1: TRIADIC RESEARCH IN SUPPLY CHAIN MANAGEMENT LITERATURE: A GATEWAY TOWARD SUPPLY CHAIN DYNAMICS

Abstract

For several decades, supply chain researchers have studied dyadic buyer-supplier relationships, describing the interactions specific to a pair of firms. Yet, this relational context turns a blind eye to the fact that firms are embedded in a larger supply network. Triads, instead, represent the smallest functional and analytical unit that allows capturing relational behaviors of firms embedded in a network. This broader perspective is relevant in light of the growing recognition of network competition and multi-actor interdependencies. This study conducts a systematic literature review of a sample of 128 articles published in leading logistics and supply chain management journals. The review catalogues triadic structures investigated in the literature and maps key themes, theories, and methods employed in the research domain. Findings reveal five dominant thematic clusters (interactions and dynamics, nature of relationships, servitization and outsourcing, governance and control, innovation), alongside the principal theoretical lenses (social capital theory, agency theory, and the relational view) and methods. The review also exposes limited attention to sustainability-oriented and reverse flows contexts, despite the increasing need to manage environmental challenges through broad supply chain collaboration. Overall, the findings offer the first comprehensive synthesis of triadic supply chain management research, clarifying conceptual boundaries and methodological approaches, and identifying avenues for future inquiry. It calls for empirical work addressing triads' role in shaping sustainability outcomes, thus positioning triadic analysis as a gateway for theorizing complex network phenomena in supply chains.

Keywords

Supply chain management, Triads, Systematic Literature Review, Networks

Introduction

The current business scenario has long been characterized by global sourcing, process fragmentation, and outsourcing activities, which have given rise to an operations and supply landscape that is increasingly based on network competition (Hayes, 2008; Ralston et al., 2017). Longer and more complex supply chains determine structural as well as behavioral issues of firms in networks, with relevant impacts on their performance (Mena et al., 2013). Moreover, as a global

society, we are now facing urgent issues that need to be tackled, such as geopolitical and economic uncertainty and increasing environmental and social concerns (George et al., 2016; Rosca et al., 2022). These issues, also defined as "grand challenges" (Rosca et al., 2022) can be tackled through multi-level action, which means by leveraging the global dispersion and embeddedness of multiple actors along the supply chain which, while operating in different economic, social and environmental systems are tied together forming a network (Montabon et al., 2016). Therefore, it becomes pivotal to recognize and address supply chains as interconnected networks, allowing for a more comprehensive understanding of the intricate relationships and dependencies among supply chain entities.

Previous research has established that insights on network phenomena can only be achieved if an investigation takes into consideration at least three actors and their relations (i.e. a triad) as the unit of analysis (Choi & Wu, 2009b; Vedel et al., 2016); however, supply chain management research has traditionally been confined to dyads (Choi & Wu, 2009a; Sengupta et al., 2018). Choi & Wu (2009b) criticized the dyadic approach to researching supply chains, arguing that dyads do not capture the complexities of networks; triads, on the contrary, represent the smallest (thus, tractable) unit of analysis which also allows for the investigation of relational dynamics, i.e., how a link affects another link and how a node affects a node (Tate et al., 2022). Therefore, triads represent a useful starting point for understanding more complex networks (Choi & Wu, 2009b).

Triadic research has subsequently developed in a sparse manner, including different constructs, definitions and contexts, all presented under the umbrella term of "triadic". Investigations include studies of one buyer interacting with two suppliers (Choi & Wu, 2009b; Patrucco et al., 2022; Ried et al., 2021; Wu et al., 2010); one supplier interacting with an intermediary and an end customer (Li & Choi, 2009; Wuyts et al., 2015), with a characterization of intermediaries offering services on behalf of the supplier, towards the customer (Bastl et al., 2019; Kalra et al., 2021; Karatzas et al., 2016). Previous literature reviews assessing triadic structures only focused on the latter configuration (i.e. service triads) (Sengupta et al., 2018; Wynstra et al., 2015), the present paper aims at sensitizing the logistics and supply chain management community to the extant research on triads structures and context, highlighting its importance to the field. To reach this aim, a systematic literature review (SLR) has been produced (Denyer & Tranfield, 2009).

This SLR contribution is three-fold: first, it offers an overview of the literature on triads within supply chain management research, as the stream has developed in a sparse manner. Secondly, it clarifies the unit of analysis of the retrieved studies and offers a categorization of available literature with respect to the actual triadic structure in focus. Third, by highlighting the themes and outcomes

that have been investigated, together with the most frequent theories and methods, it proposes venues for further research.

The rest of the paper is organized as follows: the next section provides a detailed description of the steps followed, according to the SLR methodology. Then, I present the main triadic structures emerging from previous literature, together with theories and methods used for their examination. Finally, discussion and conclusions are provided.

Methodology

The study adopts a systematic literature review (SLR) method to summarize and synthesize research in inter-organizational triads, and in turn to highlight the discrepancies between what we know and what we need to know, thus identifying research gaps and presenting possible future research avenues.

In order to secure methodological rigor and to ensure that existing information about the phenomenon is summarized in a thorough, unbiased and replicable manner, established guidelines on how to conduct a SLR have been followed (Denyer & Tranfield, 2009; Tranfield et al., 2003). The authors presented four principles (transparency, inclusivity, explanatory and heuristic) for systematic reviews in the field of management and organization studies, with five practical steps to ensure their application in the review process (Denyer & Tranfield, 2009). The steps include question formulation, locating studies, study selection and evaluation, analysis and synthesis and finally reporting and using the results. Moreover, the authors suggest producing a scoping study of the field, which consists of an exploratory review that should help define concepts and determine the review questions. Coherently, the scoping study constituted the starting point of this review and illustrated that studies claiming to adopt a triadic approach differ widely in terms of definitions, unit of analysis and structure of the triads under investigation.

The five-step procedure is detailed in the following paragraphs.

Step 1: Question formulation

The preliminary and exploratory review within supply chain management (SCM) literature revealed that articles positioned as studies of phenomena involving three companies include a wide variety of triadic structures.

As such, the present literature review aims at answering the following research questions:

RQ 1: What inter-organizational triadic structures are investigated in the supply chain management literature?

RQ 2: What are the main themes in previous research within triadic structures and which ones have received less attention?

RQ 3: Which are the most frequently used theories and methodologies in the investigation of such themes within triadic structures?

Step 2: Locating studies

Systematic reviews aim to locate, select and appraise as much as possible of the literature that is relevant to the specified research questions (Denyer & Tranfield, 2009; Durach et al., 2017). Thus, I used both the Scopus database and Web of Science to search the titles, abstracts, and keywords to identify potential articles to include in this review. Consistently with previous literature reviews, "*triad**" – limited in the subject area of Business, Management and Accounting - was used as a keyword in the search query to include variations and derivations (Vedel et al., 2016; Wynstra et al., 2015).

Step 3: Study selection and evaluation

Inclusion and exclusion criteria were defined and applied to go from a sample of potentially relevant literature to the final sample. Such inclusion criteria are based on the relevance and quality of the studies (Denyer & Tranfield, 2009). In the literature searches, made in November 2023, I included peer-reviewed articles, while conference proceedings and other reports were excluded to ensure quality and consistency (Burgess et al., 2006; Sengupta et al., 2018). No year limits were imposed.

The search was first restricted to eight SCM journals which are recognized as encompassing the primary outlets for empirical SCM research (Carter et al., 2019); their impact factors were also considered (Gligor et al., 2018).

The selected journals are:

1. Journal of Business Logistics (impact factor: 7.87);
2. Journal of Operations Management (impact factor: 7.8);
3. Journal of Supply Chain Management (impact factor: 8.02);
4. International Journal of Operations and Production Management (impact factor: 9.36);
5. International Journal of Physical Distribution and Logistics Management (impact factor: 7.29);
6. Supply Chain Management: An International Journal (impact factor: 11.26);

7. The International Journal of Logistics Management (impact factor: 5.44);
8. Transportation Journal (impact factor: 2.3).

However, I recognize that relevant studies involving triadic structures may also be published in other journals in the broader domain of business-to-business relationships (e.g., Mena et al., 2013). Thus, following previous literature reviews in the supply chain management realm, two more journals were added to the list:
9. Journal of Business and Industrial Marketing, given its focus also on supply chain issues (Gligor et al., 2018) (impact factor: 3.32);
10. Industrial Marketing Management, given its focus on industrial and business-to-business markets, which is relevant for the purpose of the study (Madhavaram et al., 2023; Sengupta et al., 2018) (impact factor: 6.96).

Next, based on title, abstract and full text reading, I manually selected the articles that represented studies focusing on inter-organizational triads, as conceptualized by Vedel et al. (2016). Thus, studies that dealt with other kinds of triadic concepts (e.g. internal triads or the resource-capabilities-performance triad) were left out. The same is true for studies that only mention a triadic context or approach in passing, but they do not contain a substantial discussion of the phenomenon (Wynstra et al., 2015). Finally, the selection of the articles is inclusive of all research methods (Durach et al., 2017).

Following this process, I first identified 128 unique articles positioned as adopting a triadic approach or investigating a triadic structure in the selected journals. Then, the screening of the articles and the application of the inclusion criteria as described, yielded a final sample of 87 articles (5 review articles and 82 research papers).

Step 4: Analysis and synthesis

This step aims to "break down individual studies into constituent parts" (Denyer & Tranfield, 2009), thus the analysis process begins with the extraction of information and the synthesis of the findings of the literature through an extraction form. To answer the identified research questions, the extraction form aims at mapping the type of triadic structure that constitutes the unit of analysis of each study; the main themes investigated; the theoretical perspective(s) – when present - adopted to explain the phenomenon under investigation; the type of study (literature review, conceptual, empirical etc.) and method used for data collection and data analysis.

The full process is synthesized in Figure 3.

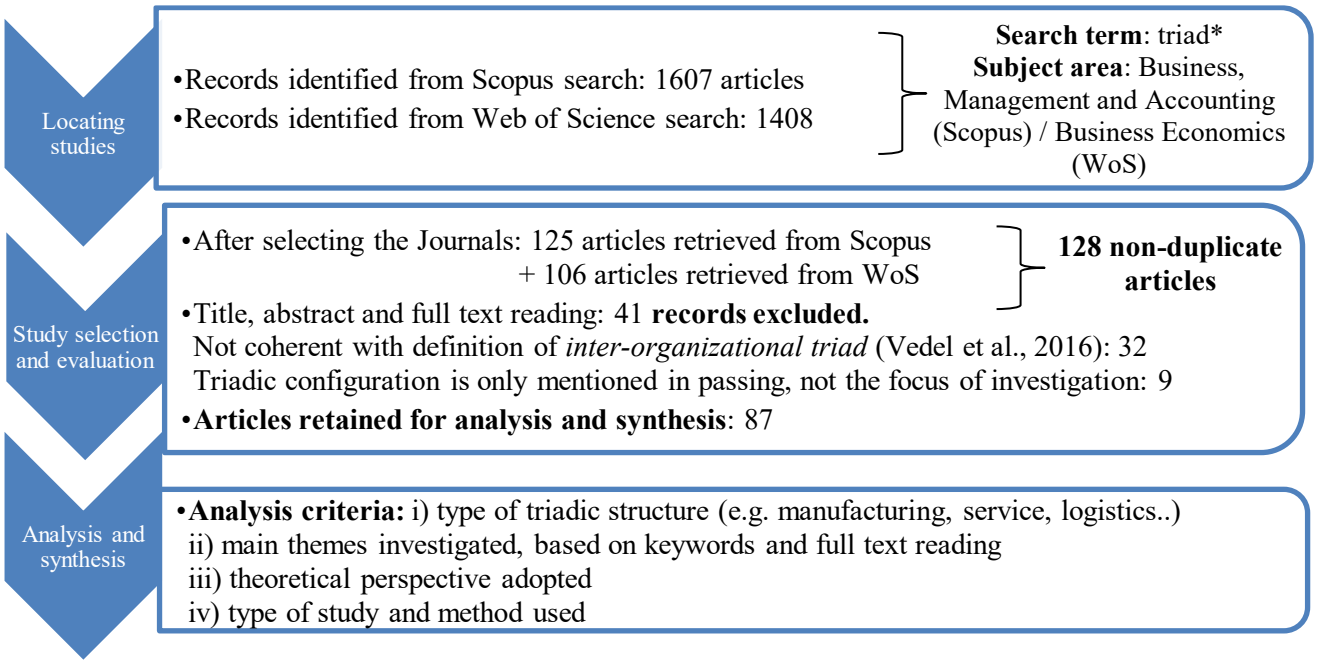

Figure 3: *Locating, selecting, analyzing, and synthesizing studies*

The final step calls for the reporting of the results, to which a separate section of this study is dedicated.

Results

Inter-organizational triadic structures in supply chain management research

For this review of extant literature, I examined studies either concerning a *triadic context* or investigating a *triadic structure* (namely, a triad) (Vedel et al., 2016). In the study, the authors determine a distinction: a triadic context refers to the study of phenomena involving three organizational actors, from the perspective of one single actor or a dyad out of three entities; thus, they emphasize the importance of the context for the unit of analysis in focus, but the other actors are seen through the eyes of a focal actor. Instead, a triadic structure involves three linked (either directly or indirectly) actors and the study of the actual working of this structure. Starting from this distinction, Vedel et al. (2016) conceptualized the inter-organizational triad, defining it as a situation when "relationships between three directly or indirectly associated actors are connected" (Vedel et al., 2016).

Even after selectively focusing on articles aligning with such definition, a broad diversity of triadic structures, involving various actors and tiers of the supply chain, as well as various phenomena, has been revealed in the literature. Consequently, a categorization of triads as presented

in the literature and a brief discussion regarding their characteristics and the state of the art seems an appropriate starting point.

First of all, a distinction between two-tier and three-tier triads is provided by Bastl et al. (2013) in their study about coalition-building behaviors in buyer-supplier relationships. Two-tier triads involve three actors, with two of them performing the same role with respect to the third actor, i.e. they involve two suppliers and a buyer. Three-tier triads, instead, involve actors that perform different roles in the overall supply chain; in their study, it is the case of a triad involving a buyer, a supplier, and a supplier's supplier. Moreover, despite not being explicitly described as such, also service triads (Li & Choi, 2009; Wynstra et al., 2015), which represent a well-established stream in the literature, adhere to this three-tier definition.

Examples of studies regarding three-tier triads comprising a buyer, a supplier, and a supplier's supplier are scarce and only recently started to appear in the supply chain management literature. Thus, I start discussing two-tier manufacturing triads, which constitute a starting point in the triadic research.

Manufacturing triads

The manufacturing triad is one of the most common triadic structures investigated in SCM research as well as one of the first ones to be conceptualized (Choi & Wu, 2009b). Such a structure, represented in Figure 4, is formed by one buyer and two upstream suppliers. In one of the first studies, Wu & Choi (2005) extended the focus from the investigation of how a buying company manages its relationship with suppliers to how the buying company actively manages and influences the relationship between two of its suppliers. Depending on the buyer's strategy and product type, five archetypes of supplier-supplier relationship were identified, which were able to capture the intricacies of competitive and/or cooperative relational dynamics. Moreover, the authors found that interactions between suppliers, or lack of, affect the performance of the buyer's supply chain operations; thus motivating further research into the matter. Within the same triad structure, Wu et al. (2010) investigated the impact of a co-opetitive supplier-supplier relationship on the supplier's performance, revealing a negative relationship between the two variables. Subsequent research described and investigated a variety of relational dynamics between the three actors, trying to explain a number of different phenomena. The studies assessed the tendency of the weaker player to build a coalition with another one, in order to gain greater power and reduce power asymmetry (Bastl et al., 2013); the contextual factors that enhance or impede supply chain integration (SCI) (Kanyoma et al., 2018) as well as the co-opetitive relationship between two first tier suppliers, which on one side determines a

greater resilience capability for first-tier supplier but on the other, counterintuitively, affects the buyer's performance negatively during disruptive events (Durach et al., 2020).

Finally, an outcome that holds particular significance is innovation capacity in manufacturing triads. Scholars explored how the interactions among the triad's components contribute to or hinder innovative endeavors, providing valuable insights into the role of triadic structures in fostering or impeding innovation within various contexts: according to specific project or product characteristics, appropriate inter-organizational coordination mechanisms and governance configurations are identified (Ateş et al., 2015; Patrucco et al., 2022) which in turn determine how actors combine complementary resources and how they exchange knowledge and information, determining different impacts on innovation project performance, in terms of time, cost and quality.

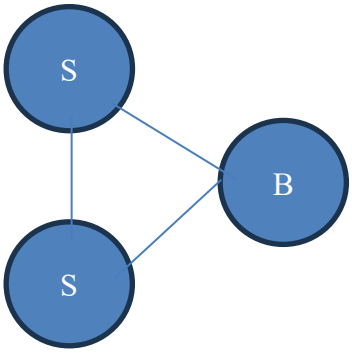

***Figure 4**: Supplier-buyer-supplier triad*

Three-tier triads

Three-tier triadic configurations were first introduced in studies investigating the outsourcing phenomena (Li & Choi, 2009), distinguishing between different structural arrangements when considering manufacturing or services settings.

In the manufacturing three-tier literature, both upstream- and downstream-facing triads are investigated: upstream-facing (i.e. back-end) triads include the buyer-supplier link (which takes place across two tiers) and one supplier that supplies to a second-tier supplier; downstream-facing triads (i.e. front-end, customer-facing), instead, include the buyer-supplier link and the buyer's customer in the investigation.

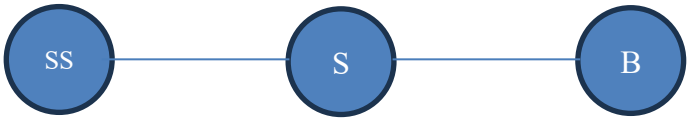

***Figure 5**: Three-tier up-stream triads*

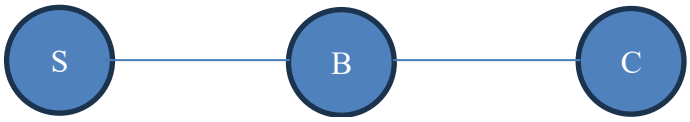

***Figure 6**: Three-tier down-stream triads*

In manufacturing three-tier triads a broad set of constructs relating to inter-organizational relationships is identified and studied, with the aim of explaining greater supply chain performance. Studies showed that the quality of the relationship in the triad determines differential outcomes, with closer, collaborative relationships – defined by trust, social satisfaction, non-coercive power, and reputation – yielding different levels of innovation capacity (Kühne et al., 2013; Mesic et al., 2018). Further studies not only provided insights into the antecedents to the formation of relational ties (Autry et al., 2014) and a detailed characterization of relationship connectors (Karatzas et al., 2016), but also revealed that such linkages are insufficient to explain supply chain performance improvements. Relational connectivity (e.g. information exchange), indeed, represents one first important step, which should be followed by the development of processual connections (e.g. cooperative norms and actor-specific adaptations to supply chain processes), that in turn determine enhanced performance (Autry et al., 2014). These two facets of connectivity (relational and processual) are synthesized in the concept of supply chain coordination (Eltantawy et al., 2015), which spans the dimensions of information flows but also financial and material ones. Through coordination, timely production and distribution are achieved, meaning higher productivity and greater operational performance for all the three actors involved (Eltantawy et al., 2015).

Additional efforts have been dedicated to measuring supply chain performance and understanding the contribution of each actor. Despite these endeavors, the literature shows shortcomings in measuring chain performance at three chain levels. In response to this gap, Kataike et al. (2019) investigated the perceived performance contribution of each chain member within the triad, revealing that each chain member's perception of chain performance contribution toward the individual performance is relatively high, however significant differences exist between the chain members about the perceived chain performance contributions. Differently, when focusing only on buyer's performance – identified as the focal firm – an investigation of the contribution of other actors within the triad to focal firm's financial outcomes was undertaken by considering how these are affected by the resource dependency of suppliers and customers (Kim & Henderson, 2015). The authors establish that there is an economic link between resource dependency - an important aspect of embeddedness (Choi & Kim, 2008; Choi & Wu, 2009b) - of suppliers and customers and a focal firm's financial outcomes even though it is not symmetrical. As further evidence of the existence of a diverse array of perspectives in the SCM literature concerning the measuring of collective

performance in a triadic supply chain, the outcomes of such relationships are investigated also from the perspective of competitive advantage gained either through the network profile (Swierczek, 2018) or through characteristics of one firm in the triad - e.g. relative supply chain management proficiency of focal firm (Ellinger et al., 2020).

The present discussion of three-tier triadic structures involved both buyer-supplier-supplier's supplier triads and supplier-buyer-customer triads. While studies focusing on service provision were purposefully left out from this section, the latter configuration is particularly distinctive of service settings. Inherent in the nature of service provision is the need for the exchange to take place between the supplier and the buyer's customer, not between the supplier(s) and the buyer. Thus, exchange in and the governance of the other relations is different (Li & Choi, 2009; Wynstra et al., 2015). This peculiarity determined the conceptualization of service triads, to which I now turn.

Service triads

Li & Choi (2009), in an investigation of the relationship structure of a triad in the context of services outsourcing, clarified the distinction between the manufacturing and the service settings. A linear diagram represents a manufacturing setting wherein a manufacturing buyer can control the interaction between its suppliers and its customers because the latter is not in direct contact with any of the suppliers. Differently, when it comes to service settings, relational dynamics change and are represented with a triangular diagram (Figure 7), to account for the direct interaction between the supplier and the buyer's customer.

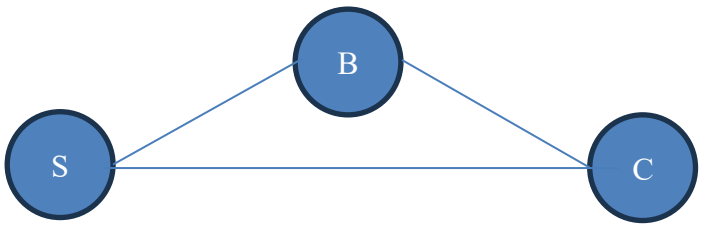

***Figure 7**: Triadic structure in service settings (i.e., service triad)*

Among the triadic structures that emerged from the literature review, the service triad stands out as the one that has received the most attention: indeed, one-third of the total number of articles retrieved through the search present the service triad as the focus of investigation. Moreover, three out of the five literature reviews that have been retrieved deal specifically with service triads, by conceptualizing and defining them as a phenomenon as well as a research topic (Wynstra et al., 2015) and by uncovering the themes along which this stream of literature has evolved (Sengupta et al., 2018).

The capability of this supply chain to deliver services, thus determining improvements in one focal firm's performance or for the whole triad, has been investigated together with causal mechanisms, antecedents, and contingent factors. Li & Choi (2009) focus on shifting relationship structures, in particular on the 'bridge' position of the buyer between supplier and customer. The buyer may decay as the supplier comes into direct contact or interaction with the customer, leading to erosion of those benefits ('bridge decay'). According to the authors, investing in communication with supplier and customer will yield information on how the supplier performs, curbing opportunistic behavior, and enabling the buyer to better control performance, avoiding the adverse 'bridge transfer' position, in which the service supplier becomes the bridge to the customer. Finne & Holmström (2013) analyze the process where subsystem suppliers bypass system integrators (buyers) and directly build relations with customers. Their case study demonstrates that the supplier's service capabilities are contingent on access to the field service sites and installed base information, which require a relationship with the customer. The nature of the relationships between actors and the level of integration and trust are major determinants of the capability of the supply chain to deliver services, thus improving the value to the customer.

Close relational ties also moderate a service provider's ability to fulfill customer needs more effectively: while service providers' high motivation to fulfill customer needs (i.e. their customer-focus) determines higher levels of customer need fulfillment, this effect is contingent on their ability to actually serve customers. In turn, such an ability is enhanced by close relational ties (Wuyts et al., 2015). Karatzas et al. (2016) investigate the influence of the manufacturer–service supplier relationship on the performance of the service supplier toward the manufacturer's customers: they provide a multidimensional description of relationship connectors and assume that there will be alternative configurations of relationship characteristics as well as of contingent factors (e.g. supplier size) that lead to high service performance. Thus, superior service performance cannot be generalized to one relationship configuration and is also contingent upon exogenous factors (Karatzas et al., 2016, 2017).

The concept of social capital is introduced to define the value that actors can derive from their relationship ties (Nahapiet & Ghoshal, 1998): Hartmann & Herb (2014) adopt the concept to show how social capital between service buyer and partner firm decreases the service buyer's opportunism risk regarding the provider's behavior, demonstrating that social capital works in parallel with formal governance mechanisms.

Further investigation of governance structures is presented by Heaslip & Kovács (2019), who highlight the importance of both contractual and relational contracts to reach an alignment of goals and behaviors between the parties involved in a service triad operating in humanitarian logistics.

Indeed, behavioral standards established in a social and relational contract are important prerequisites for the establishment and subsequent management of a formal contract (Broekhuis & Scholten, 2018). A different result emerges when considering service triads in online settings with numerous supplying partners: there, contractual and relational governance is insufficient and supplemented with further controlling and enabling organizational practices. Bastl et al. (2019) further investigate the matter of control in service triads: their findings demonstrate that both control and coordination are present in service triads, rather than just control. Controlling and coordinating activities represent a collective effort shared by two or three actors and not one focal actor's prerogative. Moreover, the customer's risk exposure due to the offering's failure, the substitutability of the offering, the contractual safeguards, and the relationship closeness are contingent factors that influence the dynamics of how service triads are controlled and coordinated (Bastl et al., 2019). While all three parties bear responsibility for coordinating a service triad (Bastl et al., 2019), the party at the bridge position is a key source of coordination failures (Kalra et al., 2021). Among the causes of coordination failures, the authors found buyer's bounded rationality, service provider's opportunistic behavior, knowledge asymmetry and unethical practices (Kalra et al., 2021). The concepts of coordination, collaboration as well as integration have been investigated also in the context of a specific service triad, the logistics triad (Prataviera et al., 2023; Vlachos & Dyra, 2020), to which a separate paragraph is dedicated.

Logistics triads

The logistics triad was first identified as the minimum unit of analysis in logistics research (Beier, 1989) and later defined as "a cooperative, three-way relationship between a buyer of goods, the supplier of those goods, and logistics service provider moving and/or sorting the goods between buyer and supplier" (Larson & Gammelgaard, 2001). Its structure is represented in Figure 8. Larson & Gammelgaard (2001), through case studies and a survey, enhanced knowledge regarding factors that facilitate and hinder triad formation as well as the benefits that the logistics triad offers (e.g. greater flexibility, higher inventory availability, more on-time pickup and delivery). Later on, the growth in specialization and outsourcing, together with global dispersion of supply chains and increasing complexity determined an interest in logistics service providers (LSP) and their role in determining the triad's performance, as they were increasingly extending their services to offer integrating solutions to their customers (Vlachos & Dyra, 2020). Hofer et al. (2014) established that a positive impact on logistics performance is determined by the nature (i.e. the long-term orientation) of a firm's relationship with its logistics service provider, which is in turn influenced by the firm's relationship marketing orientation (RMO) toward its customers. Supply chain performance, thus, is affected by the relational performance of dyads in the triad (Swierczek & Szozda, 2023), which

depends also on the relational embeddedness of LSP (Swierczek, 2023). Relational embeddedness depicts the nature of inter-organizational relationships and indicates the degree of reciprocity and closeness among participants (Rowley et al., 2000; Swierczek, 2023). Thus, while it is well documented in the literature that managing inter-organizational relationships is key to success, collaboration is strongly related to such relationships, which in turn influence behaviors and outcomes (Prataviera et al., 2023). LSPs can actively promote such collaboration, by exploiting large volumes and asset availability to increase efficiency, while improving logistics flexibility and developing regular and trustworthy relationships with the other triad members. These activities improve mutual trust and communication, which ultimately foster value creation (Prataviera et al., 2023).

A third-party logistics provider can yield positive supply chain performance outcomes also by creating efficiencies through its ability to manage supply chain costs and risk better than its clients (Vlachos & Polichronidou, 2023). In doing so, the logistics provider can play three different roles (service developer, customer adaptor, and customer developer depending on the nature of its service offerings) (Vlachos & Polichronidou, 2023).

Further mechanisms in the literature that ultimately affect supply chain performance include coordination (which implies collaborative decision-making, conflict resolution, and relationship-specific investments) and integration (which implies the provision of integrated production-distribution solutions and is reinforced by relational as well as structural embeddedness) (Vlachos & Dyra, 2020). The authors also extend the concept of the logistics triad by conceptualizing the B3B triad, i.e. multi-sourcing triads, comprising of a business customer (retailer), a third-party business solutions provider, and suppliers.

Finally, the literature search retrieved only one study specifically assessing the attributes of logistics service performance, defined as logistics service quality (Sohn et al., 2017). The authors found that several attributes of logistics service quality do not contribute to customer satisfaction, indicating the existence of a non-linear relationship between some logistics service quality attributes and customers' satisfaction.

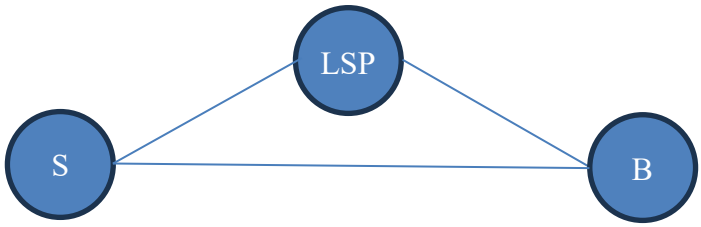

***Figure 8**: Logistics triad*

Main themes studied in extant research

Following previous literature reviews (e.g., Sengupta et al., 2018), the identification of the main themes follows a two-steps process: first, the list of keywords for each of the articles was considered, and keywords describing the focus of the research were selected to guide the formation of thematic clusters. Careful analysis of the articles in the corpus and synthesis of their findings complemented keywords, especially for the articles whereby keywords did not describe the focus (Mishra et al., 2022). Second, keywords and emerging topics were compared and clustered into coherent themes. Thus, the process of theme clustering included the development of themes in the literature, noting outliers, and making comparisons within and across studies. This iterative coding strengthens the validity of the findings (Durach et al., 2017).

This approach revealed that the most debated themes include interactions and relational dynamics, the nature of relationships, servitising and services outsourcing, governance and control of triads, and innovation.

Interactions and dynamics

In a triadic context, the relational dynamics of buyer-supplier interactions also influence the supplier-supplier dyadic relationship, thus affecting, in turn, the performance of such suppliers (Wu et al., 2010). Pardo & Michel (2015) identified and described five different effects that a type of buyer-supplier relationship can have on buyer-customer relationships in a distribution network. Similarly, the social capital between buyer and supplier in a service triad is impacted by the other two dyadic relationships in the triad (service supplier – customer; buyer – customer): through this finding, Hartmann & Herb (2015) enlightened the dynamics that lead to interconnectedness among the entities in service triads. Interconnectedness, together with the nature of interactions between parties, also determines different outcomes: first, whether value is created or not in the triad (Dapiran & Kam, 2017; Halldórsson et al., 2019); second, the service performance, which is depicted as depending not only on a combination of multiple collaborative relationships but also on various exogenous factors (Karatzas et al., 2016). Lastly, interactions between parties can also impact the distribution of power within a triad, through coalition building (Bastl et al., 2013).

Nature of relationships

The literature explores various configurations of relationships in different business settings. The third actor in a triad can both stabilize (i.e. Simmel's "non-partisan mediator") or negatively impact the structure (i.e., Simmel's *tertius gaudens*): in fact, triadic constellations are not always harmonious, as they are characterized by an inherent tension between cooperation and competition

(Wu & Choi, 2005), which is indicated by the concept of coopetition (e.g. Durach et al., 2020). For example, the structure of service triads and inherent social capital may increase the risk of provider opportunism that buyers face (Hartmann & Herb, 2014), showing competition between the parties.

Moreover, relationship quality (which includes levels of trust, commitment, economic satisfaction, non-coercive and coercive power, reputation, and conflict) has a significant influence on perceived supply chain performance (Mesic et al., 2018).

Servitising and service outsourcing

Service outsourcing appears among the prominent topics within triadic research, with service triads standing out as the most established and investigated configuration (Sengupta et al., 2018; Wynstra et al., 2015). Through service outsourcing, a firm designates a supplier to provide services to its customers on its behalf: in this context, a conflict of interest between a principal (i.e., service buyer) and an agent (i.e., service provider) that interacts directly with customers may arise (Zhang et al., 2015). Thus, servitization increases firms' exposure to uncertainty, due to the operational differences between services and production; such uncertainty is further increased when operations are set in triads (Kreye, 2017). Among the uncertainty sources, there is the risk of service failure due to the service provider. Modi et al. (2015) showed that when service failures are due to the service provider, they led to greater shareholder losses than when such failures were due to the buyer firm.

Governance and control of triads

Given the dynamic nature of relationships within triads, mechanisms to manage the relationships are deemed necessary. Li & Choi (2009) highlighted the need for a services buyer to manage their *bridge decay position* (i.e., the situation in which, during outsourcing, the service provider starts to directly interact with customers, disintermediating the buyer) by continuing to monitor the providers, the customers, and their relationships. Apart from legal agreements and formal contracts to manage and control such relationships, evidence emerged showing that behavioral standards established in a social contract are important prerequisites towards interest alignment and contract management (Broekhuis & Scholten, 2018). Finally, the effect of governance mechanisms based on punishment and incentives has also been explored (Liu & Gao, 2023).

Innovation

Innovation capacity of triadic supply chains is a recent and growing theme within this stream of literature. Improvement of such capacity depends on the characteristics of the chain as well as on relationship quality, which is measured in terms of trust, social satisfaction, non-coercive power, and

reputation (Kühne et al., 2013). The third actors - forming the triad - significantly impact innovation, with respect to a dyadic relationship: in the healthcare industry, it has been shown that third-party actors have an important role to prompt innovation and shape service ecosystems (Russo Spena & Cristina, 2019). Coherently, firms will tend to form different types of triads to achieve their project objectives, depending on where the complementary resources they need reside (in direct or indirect suppliers) and on whether they are innovating high or moderate technological complexity products (Patrucco et al., 2022). These authors present four archetypes (i.e., governance types) of triadic relationships, each having different configurations of knowledge sharing, complementary resources, and relation-specific investments and, consequently, a different impact on innovation project performance.

Counterintuitively, sustainability sits among the under-researched themes in this domain of literature that adopts a more-than-dyadic perspective. With increasing environmental concerns requiring firms to reduce the environmental impact of their business activities and a recognition that the majority of such impact lies within the supply chain (Bové and Swartz, 2016; Carter et al., 2019), the topic could benefit from further academic interest. Because sustainability impacts are not under the direct control of a single focal firm, it is necessary to involve broader parts of the network in which the firm is embedded in order to manage the supply chain with a sustainable approach. As such, a triadic research approach, by offering insights on network dynamics, can further the understanding of how to achieve such an ambitious objective. In the retrieved corpus, only two articles delved into the matter (Halldórsson et al., 2019; Sanchez-Rodrigues et al., 2010). The same can be said for returns management and reverse logistics, with only one study focusing on the topic through triadic lenses (Dapiran & Kam, 2017). As consumer returns represent a major challenge for retailers and such operations are frequently outsourced to third party logistics actors (Ambilkar et al., 2022; Russo et al., 2021), triadic research into the differential effects of supply chain structures, forms of ownership, and governance mechanisms, as well as relational variables, would allow to grasp network dynamics and be beneficial to supply chain management literature.

Theories used in the investigation of triadic phenomena

I analyzed 88 articles to determine the theories that have been used to study inter-organizational triadic phenomena within supply chain management literature. Findings indicate that supply chain researchers have drawn upon a diverse array of theories to conceptualize and elucidate these phenomena. This observation is consistent with the previous discussion concerning triadic structures, which highlighted a considerable spectrum of triadic structures and settings investigated

in the literature, with studies diverging in their exploration of phenomena, conceptual frameworks, outcome measurement, and contextual considerations. When conducting a systematic review concerning a phenomenon, theoretical divergence can lead to difficulties in knowledge development. This is because the use of different theories may result in different interpretations of the findings (Durach et al., 2017).

Table 1 reports all the theories that have been relied upon, with their relative frequency. The count of frequencies of formal theories does not coincide with the number of articles retrieved: this is because 17 studies did not mention any theoretical lens in their investigation, while around 20% of the studies relied on more than one theoretical perspective to interpret the phenomenon.

***Table 1**: Theories in triadic SCM research*

Theory	Frequency	%
Social capital theory	11	15%
Agency theory	6	8%
Relational view	5	7%
Social exchange theory	5	7%
Transaction cost economics	4	6%
Contingency theory	3	4%
Network theory	3	4%
Resource-based view	3	4%
Signalling theory	3	4%
Social network theory	3	4%
Supply chain practice view	3	4%
Balance theory	2	3%
Complex adaptive systems theory	2	3%
Resource dependence theory	2	3%
Simmel's theory on triads	2	3%
Systems theory	2	3%
Actor-network theory	1	1%
Attribution theory	1	1%
Coalition theory	1	1%
Configuration theory	1	1%
Extended Resource Based-View	1	1%
Game theory	1	1%
Institutional theory	1	1%
Organizational information-processing theory	1	1%
Prospect theory	1	1%
Resource orchestration theory	1	1%
Self-determination theory	1	1%
Social penetration theory	1	1%
Theory of swift and even flow	1	1%

Apart from formal theories, other lenses or approaches are used to study the phenomena: the Motivation-Opportunity-Ability framework (Wuyts et al., 2015), Cannon and Perreault's multidimensional relationship framework (Karatzas et al., 2016, 2017), and the IMP (Industrial-Marketing-Purchasing) approach (Andersson et al., 2019; Eriksson et al., 2021; Kovalevskaya et al., 2021). The most frequently adopted theoretical perspectives are selected and described both in their content and in their application to the retrieved studies (Sengupta et al., 2018).

Social capital theory

As shown in Table 1, social capital theory (SCT) stands out as the predominantly used theory in the investigation of triads within supply chain management literature. The concept of social capital stems from the broader sociological Social Network Theory: while a social network identifies a network of interconnected entities that represent agents, such as individuals or organizations, that can make volitional choices (Li & Choi, 2009); social capital theory assumes that an organization derives value through its relational ties with others in a network and through the environment in which it is embedded (Baker, 1990; Bourdieu, 1986; Coleman, 1988; Granovetter, 1985). Social capital, thus, mirrors the idea of relationships as network resources: capital is inherent to relationships among actors or groups of actors (Coleman, 1988), and it cannot be owned by one actor alone (Hartmann & Herb, 2015).

The concept has been used to explain how the nature of the relationship – described through structural, relational and cognitive facets of social capital - between a service buyer and partner firm impacts the service buyer's opportunism risk regarding its relationship with the service provider (Hartmann & Herb, 2014): the authors provided evidence that stronger relational capital between the supplier and product buyer in a triad reduces the opportunistic behavior of the service provider. The same authors also investigated how social capital in the dyadic relationship between service buyer and partner firm, in a service triad, is impacted by social capital in the respective triad's other dyadic relationships (Hartmann & Herb, 2015). These studies assume that suppliers and customers that are embedded in the same network of exchange relations would exhibit similar economic behavior and thus generate similar benefits and risks. However, Kim & Henderson (2015) challenge such an assumption and show differing risks of supplier versus customer dependence on the focal firm's financial performance.

Social capital has also been adopted to explain different outcomes deriving from the triadic relationship: combining SCT with Social Exchange Theory (SET), Swierczek (2019) investigated whether the manufacturer that occupies the central position (i.e. structural embeddedness) in the triadic supply chain is capable of enhancing relationships within all dyadic relationships in the triad

(relational embeddedness), in order to produce the network rent (extra profit shared among all supply chain actors). The author finds that relational embeddedness mediates the positive relationship between the manufacturer's structural embeddedness and network rent. Similarly, the author focused on the determinants of relational performance in a logistics triad, finding that buyer-supplier adaptability (described as the result of interaction between companies in supply chains, and its impact on relational performance) acts as a partial mediator between relational capital derived by buyer/supplier from the links with LSP and the relational performance (Swierczek & Szozda, 2023).

Agency theory

Agency theory has predominantly been used to investigate service triads. The central emphasis of agency theory has revolved around the issues that emerge between principals and agents when the first engages the second to undertake some action on the principal's behalf (Jensen & Meckling, 1976). However, each party acts in pursuit of its individual self-interests, which may introduce information asymmetry and conflicts of interest (Eisenhardt, 1989). Moreover, bounded rationality results in the inability to monitor each party's behavior (Eisenhardt, 1989). Service triads reflect a unique agency situation, encompassing information asymmetry and goal differences among the three entities involved. Indeed, the service buyer is in a service agreement with the customer and in an agency agreement with the service provider; the provider, instead, has to deal with and satisfy two principals, the service buyer (its client) and the buyer's customer, each of which may have conflicting objectives (Sengupta et al., 2018).

The theory has been adopted to examine a service triad in the franchising context: specifically, Zhang et al. (2015) investigate the inherent conflict of interests between a franchisor (i.e. principal) that controls and manages brand equity as a shared resource, and a franchisee (i.e. agent) that retains pricing right and profits from the identity of the brand by interacting directly with customers. Drawing on previous studies that argued that franchisees, as part of a branded chain, could free-ride on the brand and therefore lower quality and raise prices, thus leading to lower levels of operational performance, the authors find support to this agency argument related to free-riding by showing that franchisees charge higher prices than their independent or corporate counterparts, despite offering similar operational performance on the part of customers. Thus, price increases are attributed to free-riding on the brand (Zhang et al., 2015).

Agency theory also provides a theoretical basis for the effective design of contractual arrangements through ex-ante and ex-post governance, to circumvent conflicts of interest (Eisenhardt, 1989). This perspective is adopted by Broekhuis & Scholten (2018), who consider the ex-ante social contract in which a purchasing relationship originates. They found that perceptions of a cooperative

attitude and flexibility in the ex-ante social contract, during the contracting phase, allow the parties to avoid goal divergence and align interests (thus influencing the required level of contract detail and completeness), to establish a satisfactory formal contract, and then to manage this contract ex-post. Similarly, Heaslip & Kovács (2019) found that conflicts of interest are more easily reduced in favor of alignment through hybrid (i.e., contractual and relational) contracts, rather than legal arrangements.

Relational View

Conceptually close to Social Capital Theory, the Relational View (RV) is based on the idea that inter-organizational relationships may provide a superior resource-based competitive advantage with respect to firms working individually (Dyer & Singh, 1998), and emphasizes the role of reciprocal resource sharing in earning not only internal rents but also relational rents. In this vein, Swierczek (2019b) established that the manufacturer's relational embeddedness can significantly affect the relationships between its supplier and its customer in the triadic supply chains, increasing the manufacturer's eagerness to establish a direct link between the supplier and the customer (i.e., determining a direct and positive effect also on supplier-customer relational embeddedness). In turn, supplier-customer relational embeddedness has a direct and positive effect on the network rent (i.e., supernormal profits). Patrucco et al. (2022) adopted the RV to study how and why combinations of different relational design choices are related to performance within innovation projects. Particularly, drawing on different configurations of RV's constructs - governance structure, complementary resources, investment in relationship-specific assets, and substantial knowledge and information exchange – the authors determine and describe (in their relational and structural features) four archetypes of triadic relationships in innovation projects. These archetypes also impact the innovation project performance.

Social exchange theory

Social Exchange Theory (SET) posits that relational contracts develop over time based on social interactions across firm boundaries, and are expected to result in desirable outcomes for the exchanging parties when traded off against determinable costs (Blau, 1964; Homans, 1958). Indeed, companies are assumed to be self-interested actors that work with other supply chain partners in such ways that the rewards of cooperation outweigh the costs (Cropanzano & Mitchel, 2005; Lawler and Thye, 1999). Moreover, the theory posits that as the business relationship grows in both intensity and amount of formal interaction, the breadth of process-related ties will subsequently increase. Thus, it has been adopted – combined with two other social theories – to theorize the association between relational and process multiplexity within a supply chain triad setting (Autry et al., 2014). Relational

multiplexity is a status where two or more organizations are connected by multiple types of relational content (e.g., communications, cooperative norms), while process multiplexity describes the presence of multiple integrated supply chain processes (e.g., manufacturing flow or product development) between the organizations. The authors find that process multiplexity ultimately determines the improvement of performance, while relational linkages appear as a prerequisite for process integration (Autry et al., 2014).

Durach et al. (2020) build on SET to assume that, in a buyer-supplier-supplier triad, with one second-tier supplier in common, first-tier suppliers would engage in a coopetitive relationship because of the expected positive (self-interested) outcomes of this action (Lawler & Thye, 1999). Such an outcome may increase organizational resilience to an upstream disruption. In other words, the authors investigate coopetition between suppliers to verify whether it results in increased resilience (and their findings confirm such an effect) to disruptive events emanating from a lower-tier source. However, they also found that a supplier's resilience capability negatively affects the buyer's performance during disruptive events.

Methods used in the investigation of triadic phenomena

The SLR also identified the methods and methodologies used in previous literature. Contrary to the broad range of theoretical perspectives that emerged through the screening of the articles retrieved, a much shorter list of methodological approaches can be provided.

The majority of the articles in the corpus have used a qualitative approach; this indicates a frequency of "how" and "why" type of research questions in the studies (Yin, 2013). In particular, the case study methodology has been adopted in 55 per cent of the studies (Figure 9). With respect to quantitative methods, statistical analysis of survey data appears as the second most used methodology, representing around 30 per cent of the studies and showing increasing frequency only in recent years. Researchers adopting this quantitative methodology highlight the issue related to collecting relevant sample sizes of triadic data (Durach et al., 2020). One study used a simulation-based approach, and one used a scenario-based experiment. Finally, only a small portion of the articles (Figure 9) adopted a mixed-method approach.

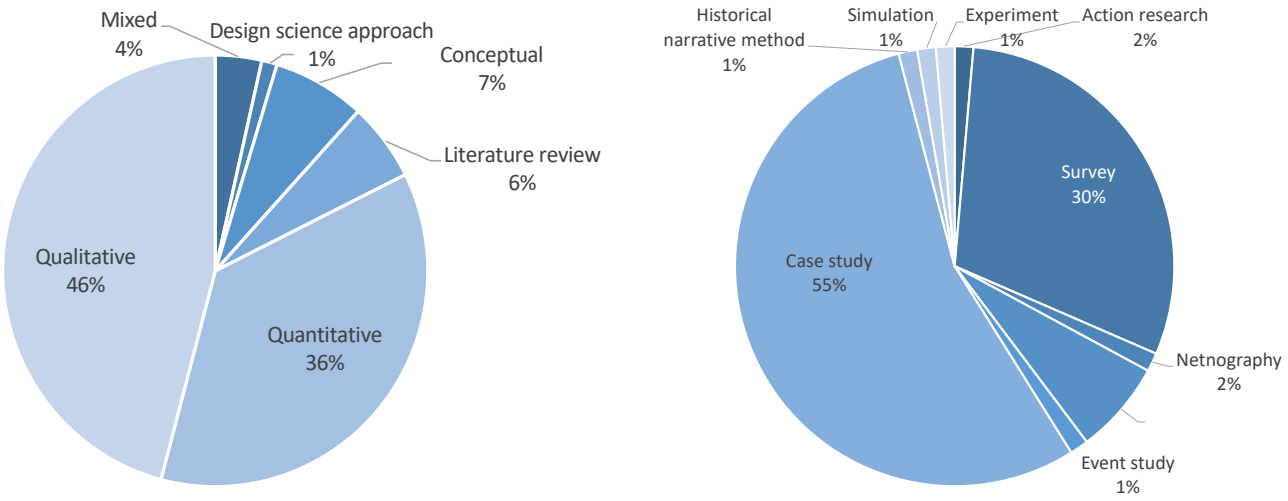

***Figure 9**: Methods and methodologies used*

Directions for future research

From a methodological standpoint, the findings of this SLR highlight that the study of more complex structures – here, triads - remains at an early stage of development, with examples of conceptual papers and a prevalence of exploratory studies. This reflects attempts to formulate and construct a theoretical framework within the realm of more-than-dyadic phenomena, with many studies adopting a theory-building approach. Coherently, future research may opt for more deductive studies to test propositions on larger sample sets and to verify the conceptual models that have been developed. One possible reason for this lack of studies lies in the extensive effort required for primary data collection from triadic structures, which also implies companies' willingness to disclose their suppliers. Thus, researchers may resort to secondary data sources and databases, such as the Bloomberg Supply Chain Database (SPLC), which allows mapping and quantifying supply networks.

As for theory-driven research opportunities, the reviewed triadic studies primarily rely on 5 theories (namely, Social Capital Theory, Agency Theory, Relational View, Social Exchange Theory, and Transaction Costs Economics). These are either grand economic theories or more sociological theories that largely look at relational aspects. While these theories are widely accepted, the SCM literature could be significantly enriched by integrating perspectives from neighboring fields such as psychology and marketing to offer new theoretical explanations for the increasing complexity characterizing supply chains. When grand theories fall short in capturing inter-organizational phenomena, middle-range theorizing becomes essential (Craighead et al., 2024) as it allows to develop context-specific insights. These may include the transformation of contextual mechanisms in light of shifts in policy or macroeconomic balances, the increasingly important role of consumers

who become a further actor to consider in supply chain dynamics, and cultural nuances in supply chain actors' behavior that may affect inter-organizational relationships.

Lastly, the reviewed studies mainly explore and analyze relational dynamics – i.e., power asymmetry conditions or opportunism - and the nature of such relations – i.e., contractual agreements or social ties – together with governance mechanisms. With few exceptions in the context of innovation projects (Fletcher-Chen et al., 2022; Patrucco et al., 2022), most studies do not embrace the study of triadic structures and relational dynamics among supply chain actors within specific contextual conditions and business problems. One topic notable by its absence is sustainability: despite pressure by policymakers and consumers to reduce businesses' environmental impact and the increasing recognition that such a goal can only be achieved when considering operations beyond a company's four walls, studies that look at triads are still scant. Previous studies have advanced calls for research that moves beyond the buyer-supplier level of contribution, especially when assessing environmental issues such as supply chain GHG emissions (Carter et al., 2015; Ellram & Tate, 2025); yet, this SLR finds a relevant gap in this domain. A triadic research approach - by offering insights on relational dynamics that are closer to network dynamics rather than one-to-one - can further the understanding of how to develop, govern, and leverage supply chain relationships to achieve environmental objectives.

Conclusions

The current operations and supply chain management scenario is increasingly based on network competition (Hayes, 2008; Ralston et al., 2017); in such a landscape, a single company can seldom successfully compete in isolation. Instead, a company's performance is tied to the relationships and interactions that it has with other actors in the supply chain (may it be suppliers, customers, or logistics service providers) (Autry et al., 2014; Ellinger et al., 2020). Therefore, it is pivotal to recognize and address supply chains as interconnected networks. In order to get insights into network phenomena, it has been argued that studies should investigate the association of at least three actors and their relations (in other words, a triad) (Choi & Wu, 2009b; Vedel et al., 2016). Coherently, studies of triadic structures are gaining momentum (Bals & Tate, 2018; Karatzas et al., 2017; Ralston et al., 2023).

This SLR presents the supply chain and logistics scholars with a state-of-the-art of the triadic growing body of literature, shedding light on the complexities inherent in triadic structures and interactive dynamics among actors. Specifically, it provides an account of the variety of triadic structures that have been identified in supply chain management research, the methods that have been

undertaken, and the theories used in the investigation. Moreover, the SLR contributes to SCM literature by outlining five clusters of research themes that have gained more attention over the years. Finally, based on the literature review findings, I identify gaps in the literature and suggest future research avenues that can grasp interactions and dependencies, together with their effects on performance, within supply chain triads and networks. Some of these research avenues are of interest and relevance both to scholars and practitioners, thus bridging the gap between academic perspectives and industry-driven topics.

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III. ESSAY 2: MULTILEVEL APPROACH TO SUPPLY CHAIN EMISSIONS REDUCTION: A TRIADIC STUDY IN THE HOUSEHOLD APPLIANCES INDUSTRY

Abstract

The urgency of climate change has led policymakers to develop initiatives and legislation that push companies to take action. Specifically, to mitigate climate change consequences, companies are expected to significantly reduce greenhouse gas (GHG) emissions from their operations. The greatest part of the environmental impact of business activities lies in companies' supply chains and is classified as indirect emissions; therefore, effectively tackling climate change necessitates approaching it by going beyond the boundaries of a single organization and engaging actors across the supply chain. Simultaneously, a commitment to reduce GHG emissions also requires organization-wide alignment, because it may produce changes in goals, metrics, investments, and supply chain partners. To investigate the multilevel facets of the phenomenon, we explore the alignment between organizational indirect GHG emissions reduction stances and day-to-day operational supply chain management activities, in the context of introducing performance metrics and practices aimed at lowering the climate impact and reporting throughout a logistics triad. The study adopts a grounded theory approach to offer insights into how multilevel alignment functions as a mechanism to go from supply chain GHG emissions reduction commitments to outcomes.

Keywords

Sustainable supply chain management, Greenhouse gas emissions, Triadic relationship, Grounded theory

Introduction

Environmental sustainability and greenhouse gases (GHG) emissions have received significant attention due to their connection to climate change. As the news reports daily, the consequences of global warming include severe weather conditions, loss of biodiversity, and health risks (CNN, 2023; Economist, 2022). As a result, reducing GHG emissions became an imperative on the minds of legislators and policymakers, with the European Union putting green transition on an accelerated timeline (European Commission, 2019) through enhanced regulatory pressure. Business world is

facing a concerted push to hold companies accountable for their carbon footprint and to establish emission reduction strategies (Ellram & Tate, 2024; Fu & Su, 2020) tackling direct GHG emissions (i.e. Scope 1 emissions) (GHG Protocol, 2024), as well as indirect emissions happening in their supply chains (i.e. Scope 2 and Scope 3 emissions) (De Stefano & Montes-Sancho, 2023; Eggert & Hartmann, 2021; GHG Protocol, 2024). Recent empirical evidence indicates that indirect GHG emissions from activities and processes that happen upstream and downstream in the supply chain represent 70-90 percent of firms' environmental impact (CarbonTrust, 2023; De Stefano & Montes-Sancho, 2023). Therefore, effectively tackling climate change necessitates approaching the issue by going beyond the boundaries of a single organization (Carter et al., 2019) and engaging actors across the supply chain.

While engaging actors in the supply chain is crucial to reduce indirect GHG emissions, an organization's top management commitment to emissions reduction equally calls for the engagement of functions within the entire organization (De Stefano & Montes-Sancho, 2023; Ellram & Tate, 2024). In fact, such a commitment may determine a change in goals and metrics, investments, partners, and supplier selection, as well as in practices across many organizational functions. In other words, committing to supply chain GHG emission reduction targets and to the implementation of related initiatives encompasses and affects multiple levels of analysis - from the internal functional level, through the organizational, to the supply chain level - as presented in the framework by Carter et al., (2015).

Organizations struggle to integrate their strategic GHG emissions reduction stances into the operational, day-to-day decision-making of internal functions (i.e., the functional level) and to align such goals and orientation with their supply chain partners (i.e., the supply chain level) (Ellram et al., 2022; Ellram & Tate, 2024; Huge-Brodin et al., 2020), highlighting the complexity of the phenomenon given its multilevel nature. Yet, extant research in this domain has mainly focused on a single, firm-level analysis, either in terms of performance, governance, or strategic approaches (De Stefano & Montes-Sancho, 2023; Fu & Su, 2020), thus offering only a limited explanation of this sustainability phenomenon characterized by a diffused origin. Studies have started to investigate different levels of analysis only within an organization, namely the transportation function and the corporate sustainability office, looking at their commitment to Scope 3 freight emissions reduction (Ellram et al., 2022). However, scant attention has been dedicated to the supply chain level, which represents a central intervention point for emissions reduction. The objective of this research is to explore how organizational indirect GHG emissions-reduction stances, day-to-day activities performed by functions, and supply chain engagement enable the supply chain under investigation to lower its overall climate impact. From these objectives, the specific research question is *how do*

multiple decision-making levels (functional, organizational and triadic) interplay towards the goal of reducing logistics and supply chain GHG emissions?

To achieve our aim, this research employs an inductive, grounded theory approach (Gligor et al., 2016; Strauss & Corbin, 1990). We enlarge the scope of the investigation to focus on a logistics triad (Larson & Gammelgaard, 2001) formed by three companies: a brand manufacturer, an OEM manufacturer, and a logistics service provider in the context of the electronic household appliances industry. The selected case allows to studying the phenomenon in its natural setting while considering the different firms' perspectives and roles. The study is exploratory and assesses a phenomenon with multiple perspectives and externalities, requiring rich qualitative data gathered through interviews with informants from different functions - such as logistics and distribution, purchasing, and manufacturing - within the three firms forming the triad.

The study responds to calls for more multilevel research in the field of supply chain management (SCM) (Carter et al., 2015), exploring the process of implementing a series of initiatives aiming at reducing indirect GHG emissions from a multilevel perspective. Moreover, it provides an understanding of the interplay of the levels that characterize SCM phenomena, highlighting the role of alignment in streamlining functional pragmatic optimization, organizational priorities and goal-setting, and inter-organizational trickling effects when tackling GHG supply chain emissions.

The remainder of the paper is structured as follows: the next section outlines the relevant literature, then we present the research method, followed by findings and discussion. The last section includes limitations and future research directions with concluding remarks.

Literature background

Supply chain GHG emissions

There is agreement within the broad sustainability literature that a sustainable economy will also need to be low-carbon (OECD, 2010; Touboulic et al., 2018). The reduction of GHG emissions from various sources such as transportation, industry and power generation towards carbon neutrality has emerged as a crucial topic to mitigate the effects of global warming and climate change (European Council, 2021). The goal is also embedded in the United Nations' Sustainable Development Goals as well as in the Paris Agreement on Climate Change (Mishra et al., 2022). The latter makes it legally binding for the signing countries to limit global warming to 1,5° C by 2030 and to reach carbon neutrality by 2050. Organizations, on their part, are under pressure by shareholders, customers, and other stakeholders (Marculetiu et al., 2023) to adopt sustainable practices that reduce or eliminate GHG emissions within the firm and the supply chain. As emphasized by both research and practice,

SCM largely contributes to the sustainability performance of firms (Carter & Washispack, 2018), with sustainable SCM practices helping organizations reduce their carbon footprint (Koh et al., 2023)

In SCM literature, the reduction of emissions appears to be a highly relevant but still emerging topic (Ellram & Tate, 2025; Mishra et al., 2022), as attested by literature reviews (De Sousa Jabbour et al., 2019; Mishra et al., 2022) and recent calls for research (Ellram & Tate, 2025; Canal Vieira et al., 2024; Zhang et al., 2024). Insights produced include drivers – such as pressures and legitimacy motivations - for pursuing emissions disclosure and emissions reduction (Böttcher & Müller, 2015; Ellram et al., 2022; Villena & Dhanorkar, 2020) as well as barriers and challenges - such as financial constraints and limited control and visibility over the supply chain (De Sousa Jabbour et al., 2019; Koh et al., 2023). As for means of reduction, extant literature mainly pursues investigations of technical approaches and internal optimization practices (e.g., carbon capture and storage technologies, carbon offsets and credits, development of low-carbon products), which require scant engagement with other actors in the supply chain (Canal Vieira et al., 2026; Koh et al., 2023). This literature either adopts a single, firm-level perspective or assumes the capacity of the focal firms to control suppliers (De Stefano & Montes-Sancho, 2023; Touboulic et al., 2018), overlooking the crucial importance of engaging and aligning with upstream and downstream supply chain actors (Canal Vieira et al., 2026). Research that accounts for a dual perspective (e.g., that of a dominant buyer and a first-tier supplier or a logistics service provider) tends to focus more broadly on adoption of environmental initiatives and green logistics practices (e.g., Huge-Brodin et al., 2020; Murfield & Tate, 2017), without looking at outcomes.

The phenomenon of reducing supply chain GHG emissions does not exist in a vacuum at a single level in real-world settings, given its complex nature. Instead, it involves different levels of analysis as, by definition, Scope 1 emissions regard the organization and its internal functions while Scope 2 and Scope 3 represent indirect emissions related to energy consumption and, most of all, supply chain activities (GHG Protocol, 2024). Studies have started to investigate multiple levels of analysis; for example, by clarifying for which legitimacy motives a transportation function and a corporate sustainability office commit to Scope 3 freight emissions reduction (Ellram et al., 2022); however, scant attention has been dedicated to the supply chain level, which represents the central intervention point for indirect emissions reduction. Suppliers' emissions are, on average, 11.2 times higher than the buying firm's own emissions (CDP, 2023): thereby, the need to reduce indirect GHG emissions, above all, highlights the limits of previous organization-centric approaches and calls for analyses that also consider the supply chain. Coherently, recent calls for research on supply chain GHG emissions prompt investigations that move towards a network or systems-level sustainability (Ellram & Tate, 2024; Gammelgaard, 2023). With a few exceptions (De Stefano & Montes-Sancho,

2023; Canal Vieira et al., 2026), however, most research lacks a multilevel investigation that takes into account how organizational strategy and objectives regarding supply chain GHG emissions affect how functions operate, which in turn can affect the organizational performance and the relationship with partners in the supply chain. The present study investigates a logistics triad, which allows proxying supply chain dynamics.

Triadic structures in supply chain management research

A triad represents the smallest functional and analytical unit of a network (Choi & Wu, 2009a) which also allows for the investigation of relational dynamics, i.e., how a link affects another link and how a node affects a node (Choi & Wu, 2009a; Tate et al., 2022). Differently, previous literature has described dyads as not appropriate to understand the complexity of modern supply chains, as they cannot capture the interactive nature that is inherent in a network (Choi & Wu, 2009b; Prataviera et al., 2023). Extant SCM literature has studied a broad diversity of triadic structures, involving various actors and tiers of the supply chain. The most common triadic structure in SCM research is the two-tier relationship among a focal buyer and two of its upstream suppliers, as a natural extension of the dyad buyer-supplier (Durach et al., 2020; Wu et al., 2010; Wu & Choi, 2005). Three-tier triadic configurations were first introduced in studies investigating the outsourcing phenomenon (Li & Choi, 2009), distinguishing different structural arrangements when considering manufacturing or service settings. The logistics service triad is a subset of the service triad, defined as "a cooperative, three-way relationship between a buyer of goods, the supplier of those goods, and logistics service provider moving and/or sorting the goods between buyer and supplier" (Larson & Gammelgaard, 2001). The growth in specialization and outsourcing, together with the global dispersion of supply chains, has led to interest in logistics service providers (LSPs) and their role in shaping the triad's performance (e.g., Prataviera et al., 2023).

In the context of sustainability and environmental impact, LSPs are crucial players as they actually perform the operations that produce a great volume of emissions (Evangelista, 2014; Huge-Brodin et al., 2020; McKinnon, 2018). Yet LSPs' green practices – i.e., those intended to minimize the environmental damage - largely depend on their customers (i.e., shippers), who are responsible for deciding which LSP to work with and which practices to implement (Huge-Brodin et al., 2020; Jazairy & Von Hartmann, 2021; Wolf & Seuring, 2010). The interplay between the two actors (shippers and LSPs) has motivated several scholars to shed light on dyadic interactions when investigating the purchase of green logistics practices (e.g., Björklund et al., 2024; Jazairy, 2020; Jazairy & Von Hartmann, 2021; Nilsson et al., 2017). Yet, LSPs usually work with a variety of shippers which may pose different requirements; a combination of such requirements will shape the

LSP's orientation towards green practices. Thus, taking into account the LSP's embeddedness in a broader network of relationships may help shed light on drivers and barriers that characterize one of the most polluting sectors (UNEP, 2024).

With a few exceptions (e.g., Jraisat et al., 2023), investigation of triadic relationships in the context of sustainability still appears to be an under-researched area. Coherently, recent publications call for research that moves beyond a dyadic, supplier-level investigation towards a supply-chain level (Ellram & Tate, 2024). We still lack an understanding of the supply chain dynamics that unfold when reconfiguring objectives and activities to meet sustainability challenges. Consistently, previous literature suggests that there are opportunities to expand the scope of scholarship in this area from the linearity of direct buyer-supplier relationships to multi-tier and multilevel studies (Carter et al., 2015; Rosca et al., 2022; Sauer & Seuring, 2018; Tachizawa & Wong, 2014). Such extension allows to consider ways in which environmental strategies are shaped through the supply chain (Touboulic et al., 2018). The present study investigates a triad, which proxies the supply chain level as in the framework by Carter et al. (2015), and expands the scope to explore how organizational and functional decisions within each firm impact supply chain GHG emissions.

Methodology

Research design

Our research approach is qualitative, as we aim at gaining further understanding into the complex interplay of different decision-making levels within a triadic structure that is tackling its supply chain GHG emissions. Grounded Theory (GT) methodology was deemed to be appropriate to explore such a multifaceted and complex phenomenon, that has not been adequately examined (Colquitt & Zapata-Phelan, 2007; Glaser & Strauss, 1967). Indeed, the exploration of SCM's role in GHG emissions reduction remains an incipient area of inquiry (Ellram & Tate, 2024; Mishra et al., 2022) with little theoretical explanation. Given the exploratory nature of our research, rich qualitative data is required: we collect semi-structured interviews through the supply chain of a multinational company in the electronic home appliances industry. The research design was based on the recommendations of Glaser & Strauss (1967), Strauss & Corbin (1990) and Corbin & Strauss (2014) and closely followed previous research in supply chain management literature (e.g. Kirchoff et al., 2016; Omar et al., 2022; Wilczewska & Nazarko, 2024).

Research context

A triad working in the electronic home appliances industry was chosen as the context of this study as the industry represents significant opportunities for GHG emissions reduction. What positions household appliances among the most polluting industries is threefold: first, it employs high amounts of energy and of polluting materials – such as aluminum and plastics – in the manufacturing process (European Environment Agency, 2020). Second, these appliances are characterized by substantial consumption of energy during their life-cycle (Rosas-Flores et al., 2011; Zhang et al., 2017), with energy use being responsible for over 75% of GHG emissions worldwide (Climate Watch, 2024). Moreover, the waste generated by electronic devices and electrical equipment at the end-of-life stage is a growing concern for producers and regulators. For example, it is one of the fastest- growing waste streams in the EU: in 2020, 10.3 kilos of e-waste (electrical and electronic equipment waste) were collected per inhabitant in the EU but less than 40% of the total e-waste produced is being recycled (European Commission, 2019).

The logistics triad (Larson & Gammelgaard, 2001) that represents the unit of analysis of the present study is composed of a buyer (here, a multinational brand manufacturer and retailer), an OEM manufacturer, and a logistics service provider that together are responsible for the production, storage, distribution, and sales of electronic household appliances (Figure 10). For anonymity, the brand manufacturer and retailer firm will be referred to as *HomeElectra*, the manufacturer as *PrimeMakers,* and the logistics service provider as *Logistics*. *HomeElectra* is a multinational group employing over 2.600 globally, and 800 in Italy. The group has started engaging in sustainability initiatives in the past five years and is working on the definition of a climate strategy for the specific purpose of reducing both direct and indirect GHG emissions. *HomeElectra* also participates in the Climate Disclosure Project initiative (CDP) and annually draws up a sustainability report. *PrimeMakers* employs around 400 people between administrative offices and production plants in the northern area of Italy and provides environmental data to *HomeElectra* for the drafting of the sustainability report. *Logistics* is responsible for warehousing of components and transportation towards manufacturing sites, as well as transportation of finished products towards its warehouses and further distribution towards commercial sites. The logistics service provider employs around 50 people, mainly as warehouse operators.

In this context, the investigation of how managerial decisions and commitment regarding indirect GHG emissions reduction initiatives, made at an organizational level, reflect on internal functions (i.e. the functional level) and are integrated into goals, practices and cognitions into day-to-day supply chain management throughout the triad, can produce relevant theoretical insights regarding multilevel phenomena and provide managerial guidance.

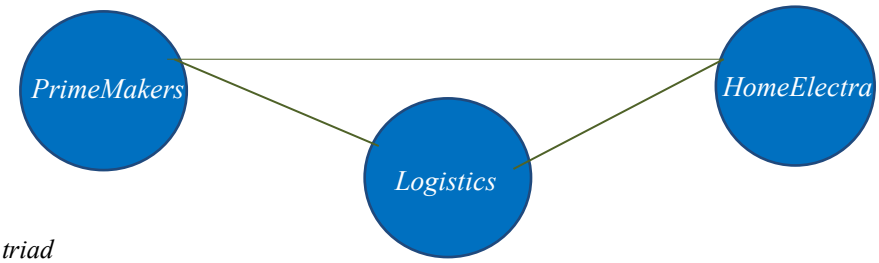

Figure 10: *Case triad*

Data collection

Following GT procedures, we use semi-structured interviews in the three firms composing the triadic relationship to gather data from field. Participants involved in the research are identified based on theoretical sampling guidelines, in conjunction with snowball effect techniques (Corbin & Strauss, 2014). The protocol calls for interviews with top managers of different functions in the three firms composing the selected triad, with the aim of grasping interactive dynamics between various levels within the organizations, as well as covering the triadic relationship. Moreover, our sample requires perceptions from personnel at varying management levels in the three firms, in order to grasp the different perspectives (Randall & Mello, 2012). Participants are selected based on a set of criteria: key involvement in logistics and SCM issues, sufficient knowledge of their firm's sustainability initiatives, and representation of different roles and levels of responsibility within the company's organizational structure. The three organizations are structured differently and job titles vary, this is especially true when identifying the respondent with responsibility for sustainability: only one firm (the brand manufacturer and retailer) has a sustainability manager, in charge of GHG emissions measuring and reporting, while at the OEM manufacturer and at the logistics service provider this responsibility is diffused and integrated into the jobs of multiple managers, therefore no single individual or function is formally responsible for sustainability. Lastly, in a few cases the initial interviews made it clear that we needed additional data; therefore, additional respondents were interviewed. Details regarding key informants are provided in Table 2.

A total of 15 structured interviews – lasting between 30 min and 2 hours - have been collected, electronically recorded with participants permission, and transcribed. Most interviews are conducted by three researchers and a debrief is done to discuss any emerging patterns after every round of interviews. In addition, each interviewer takes their own notes during each session. In line with GT development (Corbin & Strauss, 2014), the interview protocol is updated by incorporating any new, interesting topic that emerges from the data for future rounds of interviews. All interviews are collected on site and, at two locations out of three, facility tours become part of the data collection effort. Finally, to complement available information, we combine these primary sources of evidence

with notes taken during the meetings and additional secondary data, such as internal documents and presentations as well as publicly available reports and websites. This design allowed the researcher to capitalize on triangulation, combining observations from multiple researchers and different types of data from multiple sources (Pagell & Wu, 2009).

The interview protocol explores the involvement of the different functions with the organizational environmental sustainability strategy and the experience and engagement with GHG emissions initiatives at the supply chain level. Moreover, it assesses individual attitude and understanding of their functions' potential contribution to the supply chain GHG emission reduction objective. The format also includes questions regarding the relationship between functions within the firm as well as interactions with external actors such as suppliers, logistics service providers, and customers to uncover relational dynamics.

We follow two criteria to guide the number of interviews included in this study: first, we aimed to gather a broad perspective and include relevant informants related to both the organization level and the supply chain. Secondly, we stopped data collection as we were not gaining additional insights (i.e. theoretical saturation).

***Table 2**: Overview of interview participants*

Inter-view	Firm's role in the triad	Interview participant	Years of experience
1	OEM Manufacturer	CEO	30 years
2		CFO	27 years
3		Head of technical design	15 years
4		Transportation and logistics manager	20 years
5		Procurement and purchasing manager	13 years
6		Product quality director	30 years
7	Brand manufacturer and retailer	Supply chain director	20 years
8		Demand planner	10 years
9		Sustainability manager	8 years
10		Distribution logistics manager	30 years
11		Procurement and purchasing manager	5 years
12		Finance and cost accounting manager	20 years
13	Logistics Service Provider	CEO	18 years
14		Logistics Manager	12 years
15		Junior purchasing and quality manager	8 years

Data analysis

Grounded theory requires the use of a constant comparative method, whereby interpretation and analysis take place throughout the stages of data collection, coding, and theoretical development

(Glaser & Strauss, 1967). The interpretation stage began early while interviews were still taking place, with interview memos being used to track topics for further expansion (Corbin & Strauss, 2014).

The analysis phase started with open coding of meaningful concepts from each interview and was facilitated by the software NVivo. In GT, the data analysis process entails more than counting keywords or other statistics: hundreds of possible individual codes were listed and then expanded by looking at similarities, differences to bring out significant properties and dimensions of each code (i.e. axial coding). Examples of quotes are displayed in the next section, accompanied by the interview number in parenthesis. Lastly, the researcher looked for patterns across interviews to group themes into higher level core-categories (i.e. selective coding) (Corbin & Strauss, 2014; Strauss & Corbin, 1990; Wilczewska & Nazarko, 2024). This enabled the researcher to provide an explanatory scheme showing interactions and dynamics.

Findings

This section provides an analysis of the data collected from the selected triad, which is pursuing supply chain GHG emissions reduction. The overall aim of the analysis is to explore the interplay of three levels of analysis (i.e., functional, organizational and supply chain) with respect to supply chain GHG emissions. Based on their involvement in operational or strategic activities and the width of their responses, participants' responses were assigned to one or more levels of analysis. Integrating the different perspectives from the three firms allowed the researcher to saturate the supply chain level.

To begin, each interview participant was asked which supply chain actors and organizational functions they interact with the most in carrying out their daily tasks, to map existing relationships within and throughout the firms involved in the study.

The performed analysis of the interviews, in comparison with extant literature, reveals that multilevel alignment serves as a central mechanism to move from commitment to outcomes in the context of supply chain GHG emissions reduction efforts. Two core categories around which multilevel alignment needs to be discussed emerge from the analysis, namely on drives and barriers as well as on goals and measures.

Alignment on drivers and barriers to the adoption of GHG emission reduction practices

Following (Lee & Klassen, 2008; Wilhelm & Villena, 2021), I distinguish between drivers and enablers, defining a driver as a factor that motivates firms to engage in sustainability-related activities,

specifically in supply chain GHG emission reduction practices – i.e. the focus of this study. Table 3 synthesizes drivers as emerged from the interviews, categorized by company and level of analysis.

Across the three firms, the main driver to adopting supply chain GHG emissions reduction practices at a functional level is expected cost savings and/or increased efficiency benefits. Within the transportation and logistics function, such practices may include improved forecasting for load optimization and avoiding *"transporting air"* – as commented by the supply chain director at the brand manufacturer and retailer firm -, shifting to intermodal transportation, and contracting carriers that can provide information on the type of means of transport and routes they cover, enabling a computation of indirect GHG emissions produced during a specific logistics service. Thus, in line with the findings by Ellram et al. (2022), the primary motivation for the Transportation and Logistics function to put in place supply chain GHG emissions reduction practices is pragmatic legitimacy, meaning decreased costs and/or improved service – which represent tangible benefits reported also at the organizational level. Differently, emissions reduction is seen as a further benefit. The logistics and supply chain manager at the OEM manufacturer synthesizes the relationship between environmental and economic benefits as follows:

"My activity can only take place on trips and packaging, and I would say that the containment of transport costs, as we are pursuing it, is an indirect index of what we are trying to do for the environment" (#4).

The primacy of pragmatic legitimacy (Ellram et al., 2022) is true not only when taking one-time, reversible decisions but also when considering structural changes such as the exploration of alternative logistics models (e.g. centralized warehouses), as explained by a demand planner at *HomeElectra*:

"The first project that comes to mind speaking of sustainability is indeed underway: the study of a possible revision of our distribution network in Europe. We will also have to understand what impact it will have in terms of environmental sustainability […]. One day, if we had a centralized European warehouse, I think we could do much more transportation by train, that we are doing by road today, and we could probably save on CO_2 as well" (#8).

While alignment between functional and organizational levels can easily be achieved in such cases of win-win situations between economic and environmental outcomes, financial issues may also represent a barrier when implementation entails a trade-off with respect to environmental aspects or service level considerations. In such instances, achieving multilevel alignment is influenced by the underlying drivers that motivate ownership and/or top management to commit the entire organization to supply chain GHG emissions reduction. Indeed, when corporate commitment to emissions

reduction is driven by ownership's belief that "it is the right thing to do", alignment is achieved even if the commitment necessitates greater financial outlays. The finding is coherent with Ellram et al. (2022) definition of moral legitimacy. Such a scenario is observed in the brand manufacturer firm, where *"the ownership, especially the President, has always believed strongly in the issue of environmental sustainability and wanted to start concentrating attention and energy on it"* as commented by the sustainability manager (#9). Accordingly, greater investments are being made to engage forwarders and carriers that use biofuels and to offset emissions.

Conversely, in organizations where the implementation of emission reduction practices is driven by a customer, alignment between corporate stances and operational day-to-day activities is not always achieved. Specifically, when the primary driver is the customer, an ambiguous situation may arise, particularly when cost factors are deemed significant such as in low-margin sectors. This finding is in line with Huge-Brodin et al. (2020) and supported by a statement by the CEO at the LSP in our study:

"Everyone talks about sustainability, I just got back from a 4-day event on the topic. However, many in the sector are doing little because if the customer doesn't force me to do certain things or if the government doesn't give me a strong incentive to do certain things, I won't do them. Clients are afraid that if they impose requirements, prices will go up. In the end, we all talk about it a lot, but then everyone faces the issue of costs" (#13). In this situation, the customer can play both as a driver and as an inhibitor.

The same is true at the OEM manufacturer, where the input to reduce environmental impact of supply chain and operations first came from their main customer (i.e. the brand manufacturer and retailer within this study): while greater emphasis has been dedicated to developing energy-efficient products and to reducing emissions during the manufacturing phase, less attention has been given to the purchasing and transportation activities, as explained by the Transportation and logistics manager there: *"saying "we must go intermodal" must be shared with the ownership: as long as intermodal transport is competitive or cheaper than road transport, that's fine, but when an intermodal choice incurs higher costs, there hasn't been a strong direction in that regard. We've been told to favor an ecological choice, when possible, but if the ecological choice incurs significant costs…" (#4).*

Legislation and institutional pressures could be a strong driver for the adoption of GHG emission reduction practices as well as for emissions reporting (Villena & Dhanorkar, 2020), easing multilevel alignment between organizational commitments and functional day-to-day supply chain management by setting clear goals and directions. Both the brand manufacturer and the OEM manufacturer recognize that regulation could drive the adoption of behaviors and practices aiming at

reducing GHG emissions. The head of technical design at the OEM Manufacturer commented on the topic as follows:

"This is what happened with the introduction of the regulation about the reduction of household appliance consumption: it was a requirement and it forced companies to invest in research and development, maybe it would have taken 20 years of study to go there, but then they were all compliant within months" (#1).

Legislation was also mentioned as a driver for supply chain level-alignment, with the supply chain director at the brand manufacturer stating that *"there should be a very strict law that requires anyone selling you a service to be able to state what that service is: then we go and we don't just buy based on how much it costs, but also with respect to being green and sustainable" (#7).* However, vague legislative or regulatory requirement may place companies in a paradoxical situation, actually hindering the adoption of challenging emissions reduction practices and investments. As recognized by the OEM manufacturer *"We comply with regulatory aspects, but as for pushing for more, we haven't done that" (#4).* On the same line, the CEO at the LSP argues for more clarity in regulations and incentives: *"I would prefer more clarity, because for me the driving force is either the customer or the State. I would like there to be more clarity of intent, saying, "Look, we're going here" and then being sure that we're going there, because we're talking about significant investments" (#13).*

At the supply chain level, an important barrier to the adoption of emissions reduction practices relies in the ambiguity and challenges of measuring potential benefits and reporting outcomes, not only at the organization level but also involving the network of partners in the supply chain – which is fundamental when looking at Scope 3 emissions (Vieira et al., 2024). Referring to the variety in dimensions and geographical locations of their suppliers, the cost accounting manager at the brand manufacturer firm stated *"The most alarming aspect, to me, is that we [as a multinational firm] can get organized to gather the data, measure, make decisions based on that and then report, and be compliant with all regulations; but some of our suppliers do not have the knowledge, the budget nor the structure to hold up such an effort" (#12).*

Table 3: *Drivers of adoption of GHG emissions reduction practices*

Company \ Level of analysis	***HomeElectra* (brand manufacturer & retailer)**	***PrimeMakers* (OEM manufacturer)**	***Logistics* (LSP)**
Functional level	- Financial issues - Increased efficiency - LSP's ability to share information	- Financial issues - Increased efficiency	- Financial issues - Increased efficiency

Organizational level	- Owners' sensitivity - Legislation on supply chain disclosure	- Customer (B2B) - Consumer stances on product performance (B2C) - Legislation on products' energy efficiency	- Customer (B2B)
Supply chain level	- Legislation on supply chain disclosure	- Legislation on supply chain disclosure	- Legislation on supply chain disclosure

Alignment on supply chain GHG emission reduction metrics and objectives

In the triad that is investigated in the present study, the brand manufacturer represents the actor that first initiated efforts to measure, monitor and report environmental impacts – and more precisely GHG emissions – as part of its sustainability agenda. The sustainability manager reports being involved in two macro activities that represent organizational top priorities: the sustainability report with all the reporting aspects and the measuring of environmental impact (i.e. corporate carbon footprint analysis). After the brand manufacturer's invitation, the OEM manufacturer committed to measuring and disclosing Scope 1 and Scope 2 GHG emissions, too. Table 4 synthesizes different levels of corporate reporting of emissions and associated goals.

Table 4*: Scope 1, 2, 3 emissions reporting behavior and goal-setting*

Company	**External reporting of emissions**	**Scope 3 emissions reduction goals**
HomeElectra (brand manufacturer & retailer)	Report Scope 1, 2, 3 emissions via CDP questionnaire	Goal for downstream Scope 3 emissions reduction during use-phase
PrimeMakers (OEM manufacturer)	Report Scope 1 and Scope 2 emissions	None
Logistics (LSP)	No	None

The brand manufacturer and retailer's corporate carbon footprint analysis revealed not only that the vast majority of emissions is represented by Scope 3 emissions – as largely confirmed by literature (De Stefano & Montes-Sancho, 2023; KPMG, 2024) – but that such emissions are generated mostly downstream, with 85% of it happening during the product-use phase. This metric of Scope 3 emissions played an important role internally, both in decision-making and in delineating the

company's decarbonization strategy. Indeed, it steered resource allocation and investment priorities towards R&D activities on products and packaging, as confirmed by the sustainability manager:

"We are definitely active in the research and development part: we've initiated a project with a university to focus more specifically on the product itself. All this is aimed at increasingly focusing on R&D, because clearly everything starts from there; that's where we begin to implement the entire eco-design, to eventually arrive at producing less impactful products" (#9).

R&D activities involved both the staff of internal technical offices and laboratories at the brand manufacturer as well as those at the manufacturing plants (including at the OEM manufacturer involved in this study). Such projects encompass material innovation and material reduction in packaging, improved performance, and reduced energy consumption during the use-phase of products. A variety of interviewers mentioned these kinds of initiatives, signaling great organizational emphasis and multilevel alignment on this goal, as functional efforts receive organizational recognition.

"There have been various activities I've been involved in, where we account for how much material we include in our packaging, and here too there's a lot of discussion about packaging: so how much does the polystyrene packaging weigh in kg, how much does the cardboard weigh..." (#11).

"Concerning environmental impact, there is an ongoing project regarding packaging materials, specifically the elimination of plastic and its impact on the final customer." (#5).

"Related to the product, there is a continuous and ongoing research for the reduction of energy consumption, which in this field also includes water usage, as the machine must consume less" (#6).

While the finding is in line with previous literature, confirming that, when companies' emissions are primarily linked to downstream activities, companies mention product development, training for correct usage, and increasing the circularity of their products as the main opportunities to reduce emissions in their strategies (Vieira et al., 2024), it also highlights the limits of focusing on post-purchase phases, because companies exhibit limited visibility and control over this phase.

Looking upstream, significant discrepancies exist across functions and supply chain boundaries in defining KPIs, as functions such as procurement, logistics, and transportation, lack specific indicators and goals related to GHG emissions (Miemczyk et al., 2012). This has perpetuated a "business-as-usual" approach, especially at the brand manufacturer and LSP provider firms – coherently with the type of driver that pushes for GHG emissions reduction, as discussed in the previous paragraph. Such functions prioritize traditional cost-minimization and service-maximization objectives in their day-to-day decision-making process, whereas possible savings in terms of

environmental externalities are perceived as additional benefits. Some procurement professionals noted:

"We were told to choose a more sustainable option when we are in the conditions to; that is, when every other clause in terms of price, quality, and service remains the same. That does not happen the majority of the time, and we rarely have indicators for this kind of evaluation" (#5);

"In our supplier selection strategy, there isn't a strong emphasis on choosing the most sustainable material or the somewhat more sustainable supplier, yet" (#11).

Therefore, in this triad, multilevel alignment between organizational and functional goals and indicators is achieved only with respect to some functions (i.e. technical design, laboratories) that represent the priority within the sustainability strategy. Table 5 synthesizes the main metrics and goals for the different levels of analysis around the triad.

***Table 5**: Environmental sustainability and GHG emissions reduction metrics and objectives*

Company \ Level of analysis	***HomeElectra* (brand manufacturer & retailer)**	***PrimeMakers* (OEM manufacturer)**	***Logistics* (LSP)**
Functional level	**Metrics**: Product LCA	**Metrics**: KwH and water consumption per use (at the design and production stage)	**Metrics**: waste from warehouse activities, unnecessary moves in the warehouse, unloaded truck trips
	Goal: Market a product with increased efficiency and fewer energy/water consumption	**Goal:** - being compliant with energy label directives - design and manufacture household appliances with reduced KwH and water consumption	**Goal**: none
Organizational level	**Metrics**: Scope 1, Scope 2, Scope 3 (corporate carbon footprint)	**Metrics**: energy efficiency of production plants; self-generated solar energy/total energy consumption	**Metrics**: self-generated solar energy/total energy consumption

	Goal: Downstream (use-phase and distribution) Scope 3 emissions reduction	**Goal**: (no specific goal set, however continued investment is planned)	**Goal**: (no specific goal set, however continued investment is planned)
Supply chain level	**Metrics**: Scope 3 emissions **Goal:** carbon neutral by 2050	None	None

This kind of discrepancy in terms of measures and goal-setting also hinders a trickling effect of emissions reduction awareness and commitment towards supply chain partners, especially as boundary-spanners functions (e.g. purchasing and procurement) are not considered top priorities within the sustainability strategy. The LSP admits receiving no exact requirements regulating sustainability or GHG emissions from buying firms when they purchase logistics and transport services:

"There's really little incentive from clients and no specific clauses are included in the logistics outsourcing contract to regulate aspects related to environmental sustainability. In our sector, the push to invest, innovate, change comes from them" (#13).

Contrary to findings in prior studies, where LSPs prioritized environmental aspects more than their customers (Huge-Brodin et al., 2020), here they seem to perceive low interest from their customers, therefore they are not motivated to push the adoption of environmentally sustainable practices. From the perspective of the buyer of such logistics services (e.g. transportation and logistics function at the OEM manufacturer and at the brand manufacturer), their decision-making is constrained by minimal accountability, due to lack of accurate and comparable emissions data, as well as limited resources allocated. Such a limited margin for action results, in turn, from a lack of alignment between upstream-looking functions with the organizational sustainability strategy. On the topic, a logistics professional at the OEM manufacturer firm argued:

"When I don't have any data about the environmental impact of a solution, it is hard to uphold a buying decision that seems to be more sustainable but determines an increase in the price of the logistics service. Differently, price and logistics service indicators are objective and easy to compare" (#4).

In summary, while the brand manufacturer has pushed progress in goal-setting for downstream activities, the lack of a comprehensive, multilevel alignment of objectives and related

metrics —especially upstream—diminishes the overall effectiveness of the sustainability strategy within the logistics triad.

Discussion and implications

New sustainability legislation, announced carbon-neutrality targets and growing pressures from policymakers and customers have created an unprecedented need for global brands to ensure GHG emissions reductions throughout their extended supply chains. In order to do so, firms need to integrate their decision-making frameworks with environmental impact concerns. However, this process is highly complex – as it involves the entire organization as well as its supply chain - and still lacks an in-depth analysis, particularly when it comes to the investigation of how different decision-making levels, that exist within supply chain management phenomena (Carter et al., 2015), interplay towards the goal of reducing logistics and supply chain GHG emissions. This study addressed this gap through a grounded theory study of a logistics triad tackling the issue, providing insights on how alignment (or lack of) throughout decision-making levels allows (or hinders) to move from GHG emissions reduction commitments to outcomes. Moreover, the study extends previous research with a strong focus on firm-level analysis (Ellram et al., 2022; Fu & Su, 2020; Nilsson et al., 2017) by broadening the perspective to involve three actors within the same supply chain.

Specifically, the findings reveal that alignment between functional day-to-day supply chain management and organizational stances and priorities is easily achieved when the two decision-making levels are encouraged by the same driver: cost reduction and/or enhanced efficiency. When supply chain GHG emissions reduction practices and initiatives also combine financial benefits or improvements in service level, alignment eases the implementation process. This finding supports Ellram et al. (2022). Conversely, in cases where a function is driven by specific regulations or an organization embarks on a path of emissions measurement and reduction at the request of a customer, situations may arise where functional-level actions are constrained by the company's priorities. The allocation of tools and resources to support these actions may be limited if they do not align with broader strategic objectives. This misalignment underscores the challenges of ensuring consistency across functional and organizational levels when drivers diverge, complicating the effective implementation of emissions reduction initiatives and increasing the risk of functional-level initiatives being fragmented or deprioritized.

At the supply chain level, institutional pressures and regulation can ease inter-organizational alignment by setting clear goals and directions. Recent studies have explored what sources of pressure drive suppliers and partners to voluntarily disclose their carbon emissions (Villena & Dhanorkar, 2020) and to implement sustainable supply chain management practices to reduce emissions

(Marculetiu et al., 2023), this study expands on the need for regulation to set clear, even challenging goals, accompanied by metrics and practical guidance. Otherwise, weak or vague regulations may halter supply chain level alignment, generating differing priorities and expectations among supply chain partners.

In terms of managerial implications, this paper posits that supply chain GHG emissions reduction cannot be achieved without multilevel and inter-organizational alignment. Managers can apply findings to help guide decisions related to implementing emissions reduction initiatives, thus considering specific drivers and barriers, engaging internal functions in goal-settings, and allowing for integration of sustainability-related indicators into the day-to-day decision-making framework. Managers at global brands should recognize their power and the share they represent within their supply chain partners' customer portfolio: this power may be used not to aggressively alter partners' commitment, rather to share clear goals which can incentivize action in the supply chain. In our study, the LSP claims to be ready to act but, because they perceive lack of clarity in their customers' intentions concerning emissions reduction, they are not implementing any initiative that does not guarantee a cost benefit in the first place.

Finally, these results also offer managers a description of the factors and possibly ambiguous dynamics that lead (or hinder) inter-organizational alignment concerning environmental sustainability and supply chain GHG emissions specifically. Firms can use this information to assess some of the difficulties they are facing and root causes of success/failure in their process to net-zero, to take corrective actions.

Limitations and future research

This research has several limitations, which also offer opportunities for future research. Overall, the study assesses a single supply chain within a single country, that of a global household appliance brand based in Italy, following rather than representing a sustainability leader in the industry. Therefore, results may not be generalizable to other manufacturing settings, given specific legislation existing in this industry as well as other relevant contextual factors. Future research should seek to address this research objective by considering not only other regions of the world but also a more geographically dispersed triad, whereby the actors work in different contexts (e.g. developed and developing countries). This could improve the external validity of current findings and lead to new discussions.

Another limitation is inherent in the grounded theory methodology, where a variety of topics and variables may emerge due to extensive data collection from a variety of sources. Scale

development on the concept of alignment may allow further research that empirically tests the present findings, also enlarging data collection to a greater number of triads, covering different sectors. A second limitation related to the methodology regards the risk for the researcher to insert biases in the data analysis process; in this regard, a variety of measures to prevent this have been taken (see methodology section for details).

Finally, this research does not assess upstream suppliers' perspectives on the issue of supply chain GHG emissions reduction, which represents a significant limitation in the analysis of scope 3 emissions. This omission is critical not only because suppliers constitute a pivotal node in the literature on sustainable supply chain management, but also because it excludes potential considerations of power dynamics and differing legislations that could influence emissions reduction practices and outcomes. Further studies may go beyond the concept of the triad and assess the issue by adopting a systems perspective (Gammelgaard, 2023).

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IV. ESSAY 3: COPING WITH PARADOXICAL TENSIONS IN SUPPLY CHAIN EMISSIONS REDUCTION: THE ROLE OF MANAGERIAL COGNITION AND ORGANIZATIONAL FACTORS

Abstract

Reducing supply chain emissions requires organizations to confront persistent tensions between economic performance, operational efficiency, and environmental goals, among others. Drawing on paradox theory, this study unpacks the factors that characterize a company effectively reducing its supply chain emissions. Specifically, we examine how individual cognitive frames and organizational factors contribute to management responses to the tensions involved in this process. A qualitative case study of a sustainability-oriented company in the beauty and cosmetics industry was conducted through in-depth interviews across procurement, R&D, logistics, and sustainability functions. We identify how leadership behavior and commitment, together with shared decision-making guidelines based on objective measurement, foster an organizational environment that enables individual managers to make sense of and cope with paradoxical tensions. At the individual level, managers develop or strengthen a paradoxical cognitive frame, supported by technical and scientific knowledge, redefining sustainability tensions as solvable technical or design problems rather than mutually exclusive goals. These paradoxical cognitive frames also extend beyond the firm, facilitating managers to communicate sustainability priorities to suppliers, enhancing collaboration, and generating a positive spillover effect of environmental metrics and practices in their supply chain. The study contributes to sustainable supply chain management literature by uncovering the interplay through which individual-level and organizational mechanisms jointly sustain paradox management on a decarbonization path, offering insights on how organizations can foster "both–and" responses to effectively manage competing business demands in supply chain emissions reduction.

Keywords

Sustainable supply chain management, Decarbonization, Paradox Theory, Cognitive Frames, Organizational Frames

Introduction

Climate change is widely regarded as one of the most pressing issues of our time, as further evidenced by the increasing frequency of extreme weather events, droughts, biodiversity loss, and substantial global costs associated with infrastructure damage. Greenhouse gas (GHG) emissions,

with carbon dioxide being the most common, are a primary contributor. Policymakers worldwide, along with advocacy groups like the United Nations Sustainable Development Goals and the Science Based Targets initiative, are actively working to reduce emissions and the effects of climate change (IPCC, 2018; Wieland & Creutzig, 2025). The Paris Agreement on Climate Change was adopted by 195 parties globally and aims to limit global warming to well below 2°C relative to pre-industrial levels. To stay within this limit, signing countries are required to reduce their GHG emissions by 43% by 2030 (UNFCCC, 2015; IPCC, 2018). Consequently, measures to cut emissions are taking center stage within companies' environmental, social, and governance (ESG) strategies even amidst national climate policy shifts (Ellram & Tate, 2025; Velázquez Martínez et al., 2025).

Supply chains represent a central intervention point for solving the climate crisis, as the majority of emissions are generated here. Indeed, sectors including industry and manufacturing, power and energy, and transportation represent over 50% of global GHG emissions (Ritchie et al., 2020; UNEP, 2024). A leading carbon disclosure system's report showed that an organization's upstream supply chain emissions were on average 26 times higher than its own emissions (CDP, 2024), while Apple reports that nearly 100% of its 2023 emissions were generated outside of its Scope 1, direct emissions (Apple, 2024; Wieland & Creutzig, 2025). On average, Scope 3 emissions (defined by the GHG Protocol as indirect emissions from suppliers, transportation, product use, and all other parts of the supply chain) form up to 80% of overall emissions for most companies (CarbonTrust, 2023; McKinsey, 2024; Ellram & Tate, 2025). As such, Scope 3 emissions remain the most difficult area of corporate climate management (Velázquez Martínez et al., 2025; Vieira et al., 2024).

Literature on supply chain Scope 3 emissions has highlighted the need to invest and innovate across multiple domains (Zhang et al., 2024): from low-carbon and energy-efficient technologies (Song et al., 2023; Xu et al., 2023), to alternative, greener transportation means (Björklund et al., 2024); from supply chain transparency (Dahlmann et al., 2023; Villena & Dhanorkar, 2020) to collaboration with suppliers for emissions disclosure (e.g., De Stefano & Montes-Sancho, 2024; Villena, 2019). Studies have also drawn attention to the inherent challenges associated with addressing sustainable supply chain management issues – and GHG emissions more specifically -, given competing performance demands upon supply chain partners and organizational functional areas, which often result in the emergence of tensions and undesired side effects (Dahlmann et al., 2023; Roehrich et al., 2014; Toniolo et al., 2025; Xiao et al., 2019;). A well-known example concerns the tensions of balancing economic and environmental factors surrounding the adoption of electric vehicles (Björklund et al., 2024). While extant literature has raised some key issues on drivers and barriers around supply chain GHG emissions, we still know relatively little about how tensions and

the way in which they are managed influence progress towards supply chain GHG emissions reduction.

Paradox theory offers a valuable theoretical lens for investigating this phenomenon, as it conceptualizes tensions arising between two extremes of a paradox. Paradoxes are defined as interests that are logical in themselves but become irrational or contradictory when considered together (Poole & Van de Ven, 1989; Smith & Lewis, 2011; Lewis & Smith, 2022), as in the case of reduced environmental impact that implies increased costs. Paradox theory also finds that how paradoxes are navigated in organizations has significant implications for organizational performance (Smith and Lewis, 2011). A critical element influencing the management of tensions lies in the individual cognitive frames of decision-makers (Hahn et al., 2014; Waldman et al., 2019), with studies suggesting that a paradoxical framing enables decision-makers to cultivate the ability to embrace and engage contradictions (Hahn et al., 2014; Xiao et al., 2019). Such cognitive frames are only partially innate, as they are also shaped by organizational factors (Benkert, 2020; Preuss & Fearne, 2021; Xiao et al., 2019). Thus, we examine the management of such tensions by juxtaposing two levels of analysis. Specifically, we explore how organizational-level elements and individual-level cognitive factors enable tensions management, in the context of implementing a series of initiatives to decarbonize a firm's supply chain.

Decoding tensions provides an increased understanding of why the transition towards lower-emitting supply chains is going slowly (Björklund et al., 2024; Cenci et al., 2023; Sallnäs & Huge-Brodin, 2018), thus underscoring the importance of investigating factors that shape how tensions are perceived and navigated. To do so, we posit the following research question: *how do individual cognitive framings and organizational context factors contribute to paradox management, thus allowing for an effective management of supply chain emissions?* We address the research question through a single case-study (Ketokivi & Choi, 2014; Yin, 2014) of a best-in-class organization in the cosmetics and beauty industry. Building on interviews and secondary data, we conduct an analysis with a point of departure in paradox theory.

Conceptual background

Management of supply chain GHG emissions

Management of supply chain GHG emissions has climbed up the environmental sustainability discourse, becoming a top issue both within corporate agendas and within the management academic literature. Such an increase in attention is due to the alarming reports from climate experts, and the increasingly frequent consequences of climate change with severe economic impacts on business

activities (Ellram & Tate, 2025; Wieland & Creutzig, 2025). Therefore, firms are increasingly pressured to reduce GHG emissions (hereinafter referred to solely as "emissions") both by legislators and by consumers and customers. Specifically, businesses are expected to take responsibility and report not only their direct emissions but also the more complex and dispersed Scope 3 emissions arising across their supply chains (Fu & Su, 2020; De Stefano & Montes-Sancho, 2023).

Empirical research on supply chain emissions has only recently begun to gain traction within the discipline (Hettler & Graf-Vlachy, 2024; Wieland & Creutzig, 2025). Scope 3 emissions in freight transport have been investigated to shed light on the legitimacy motives that move different organizational functions towards such a goal (Ellram et al., 2022). Existing studies primarily focus on specific, narrow practices (Ellram & Tate, 2025) in the supply chain transparency and reporting domain: institutional pressures that elicit suppliers' involvement in carbon transparency have been enlightened (Villena & Dhanorkar, 2020), together with the impact of emissions disclosure by customers on suppliers' emissions performance (Hettler & Graf-Vlachy, 2024; Song et al., 2024). However, while motivational drivers and reporting practices are crucial steps for planning and implementing effective practices, they do not directly lead to adoption of management practices that allow addressing this diffused sustainability issue. Indeed, given the interdependence of emissions sources, achieving emissions reduction objectives requires a combination of organizational initiatives and investments, covering vast areas of a company's internal organization and its supply chain.

Looking at corporate action, data shows that many companies still struggle to take effective action in reducing the environmental impact across their supply chains and that the majority of companies' emissions pathways are still misaligned with the targets set by the Paris Agreement on Climate Change (Cenci et al., 2023; Wieland & Creutzig, 2025). Such evidence persists despite an increasing number of climate pledges by companies and growing pressure from policymakers and demand. The lack of progress suggests that companies may face substantial tensions in reconciling emissions reduction programs with other, often competing, performance demands (Cichosz et al., 2025; Roehrich et al., 2014; Wright & Nyberg, 2017) and signals limited capacity for firms to manage such tensions in practice. This raises the need to clarify how organizations that are effective in reducing their emissions look like, internally and throughout their supply chain, as these are the organizations that are equipped to also address the competing tensions surrounding supply chain emissions reduction. Our study unpacks the factors that characterize a company that is effectively reducing its supply chain emissions, applying the lens of paradox theory to examine tensions and management responses involved in this process.

Paradox theory and coping with paradoxical tensions

Paradox as theory research explores how paradoxes are organizationally conceived of, and responded to, and finds that how paradoxes are navigated has significant implications for organizational performance (Smith & Lewis, 2011). A crucial aspect of paradox theory lies in its articulation of paradoxical tensions - elements that, while individually logical, present contradictions when considered collectively (Smith & Lewis, 2011). These paradoxical tensions typically manifest as two contradictory poles, or objectives, that organizations must manage simultaneously. Previous research has identified four predominant types of paradoxical tensions: performing; belonging; organizing; and learning (Lewis & Smith, 2022). Performing paradoxes emerge from competing goals of different stakeholder, as observed in sustainability efforts that strive to balance the three pillars of sustainability (economy, environment, and society) (Hahn et al., 2018). Organizing paradoxes arise from conflicting organizational design logics, such as the trade-off between centralization and decentralization—a dilemma frequently noted also in supply chain management (Dahlmann et al., 2023). Belonging paradoxes refer to the dissonance between individual and collective identities, these are rooted in divergent values across hierarchical levels; finally, learning paradoxes capture the tension between leveraging existing knowledge and embracing innovative practices and insights, which is particularly salient when organizations must simultaneously exploit current capabilities while exploring new possibilities (Lewis & Smith, 2022; Maalouf & Gammelgaard, 2016).

Secondly, paradox theory offers insights into management responses to tensions, focusing on either the fostering of virtuous circles by valuing both poles of a tension ("both-and" approaches) or the induction of vicious circles that privilege only one such pole ("either-or" approaches) (Schad et al., 2016; Smith & Lewis, 2011). Such responses are influenced by managerial cognitive framings, defined as how managers interpret stakeholders' pressures and make sense of the ubiquitous tensions in sustainability (Hahn et al., 2014; Smith & Lewis, 2011; Xiao et al., 2019). In other words, the way managerial decision-makers frame sustainability issues in their mindset influences how sustainability tensions are managed at the organizational level.

Existing studies within SCM literature on paradoxes have largely focused on identifying and describing paradoxes that arise in specific case examples (Björklund et al., 2024; Dahlmann et al., 2023; Moncef & Monnet, 2021). For example, Björklund et al. (2024) characterized the different tensions emerging in the process of greening transportation in a buyer-supplier dyad, suggesting an explanation for why the transition toward green transportation goes slowly, despite the high ambitions of involved actors. However, scant research has moved beyond describing paradoxical tensions to investigate how these are navigated and what factors enable management responses to tensions. To

the best of our knowledge, Wang et al., 2025 were the first to explicitly look at management responses to paradoxical tensions; yet, they do so in the healthcare operations context.

Attempting to achieve sustainability goals in supply chains involves multiple tensions (Hahn et al., 2014; Montabon et al., 2016). While the adoption of the paradox perspective to managing sustainability challenges is a "relative newcomer" to SCM research (Carter et al., 2020), this theoretical lens has significantly emerged in the last decade in the corporate sustainability field (Hahn et al., 2014) as well as in management and organization studies (Smith & Lewis, 2011). Thus, we bring insights from these fields to SCM literature. Previous studies integrated paradox theory within the investigation of managerial cognitive frames, proposing the existence of a business case frame – characterized by a prioritization of economic performance at the organizational level ("either-or" approach) – and a paradoxical frame – which pertains to managers prone to addressing economic, environmental, and social concerns at organizational and societal levels simultaneously ("both-and" approach; Hahn et al., 2018). These studies suggest that paradoxical thinking allows managers to develop a comfort with tensions that enables more complex and challenging response strategies (Hahn et al., 2018; Xiao et al., 2019). Further empirical research, however, provides evidence that paradoxical framing alone does not always produce the most desirable outcome in sustainability contexts. Rather, more attention needs to be given to the organizational and supply chain contexts that accompany such tensions (Benkert, 2020; Wright & Nyberg, 2017; Xiao et al., 2019).

Unfortunately, there remains a significant gap in our understanding of what factors characterize firms that are effective in addressing sustainability-related tensions and that are, in turn, making meaningful progress in reducing supply chain GHG emissions. Therefore, in this study, we investigate organizational factors that may influence the tensions that managers perceive and how they react to them in light of individual-level managerial cognitive frames. We argue that these factors shape management responses to the paradoxical tensions in a firm seeking to reduce emissions throughout its supply chain.

Methodology

Research design

Our research approach is qualitative, as we aim at gaining further understanding into the interplay of organizational and managerial cognition factors that characterize an organization that is successful in managing emissions-related tensions throughout its supply chain. We conduct a case study for theory elaboration (in our case, paradox theory) to enhance its explanatory power and applicability (in our case, paradoxical tensions and management responses in the context of supply

chain emissions reduction). In line with previous literature (Benkert et al., 2020; Xiao et al., 2019), we juxtapose two levels of analysis, namely the organizational level and the individual level, as this allows to explore how factors pertaining to the organizational context and to individuals' cognition interplay for an effective reduction of supply chain emissions.

The research design was based on the recommendations of Yin (2014) and Ketokivi & Choi (2014) and closely followed previous research in logistics and supply chain management literature (e.g. Ellram et al., 2022; Mies et al., 2025). The need for rich empirical evidence and theoretical explanation, as well as the invitation to provide actionable managerial guidance, suggested an exploratory approach for our research. A single, in-depth case study design involving managers in different functions within the selected firm was deemed appropriate to produce a detailed description of the phenomenon: we collected 9 semi-structured interviews throughout different functions (namely, board members, sustainability, logistics, procurement, R&D) at an Italian company in the beauty and cosmetics industry.

Research context

A company working in the beauty and cosmetics industry was chosen as the context of this study. For the purpose of anonymity, the case will be referred to as *Cosmetics*. The selected organization is responsible for the formulation, production, distribution, and sales of skincare and haircare products. *Cosmetics* is a multinational group headquartered in Italy, with eight international affiliates; it employs over 1.000 people globally, half of which in Italy, where formulation and production processes are based.

The main reason for this case selection regards the recognition of the company as a best-in-class organization in terms of measuring supply chain emissions and reporting, as well as implementing initiatives by partnering and collaborating with actors throughout its supply chain. Precisely, the company became a B Corp in 2006. Moreover, it has more recently set ambitious, science-based emissions reduction targets according to the Science Based Targets Initiatives (SBTi), which include a reduction of 50% in Scope 3 emissions by 2030 and net-zero by 2050. In terms of disclosure, the company engages in CDP disclosure as well as in extensive measuring and reporting through a comprehensive sustainability report. Finally, the company launched its climate strategy last year, which includes four pillars, the first one being decarbonization and explicitly including actions regarding supply chain, energy, and materials. The other three pillars are circularity, biodiversity, and water management. The selection responds to calls for research that engages with best-in-class organizations to understand what effective practice is (Ellram & Tate, 2025).

Moreover, the beauty and cosmetics industry represents significant opportunities for emissions reduction throughout its supply chain. This is due to the huge variety and types of raw materials - which frequently include chemicals and microplastics, characterized by complex extraction processes (Cubas et al., 2022) -, the pervasive presence of packaging, as well as intensive logistics and transportation processes related to procurement and distribution phases.

Data collection

To gather data from field, we used semi-structured interviews and field observations through a company visit as primary data sources. Participants involved in the research are identified based on theoretical sampling guidelines, in conjunction with snowball effect techniques (Bryman & Bell, 2022), whereby during an interview, other responsible people were mentioned as involved in the process of planning, measuring, and executing initiatives related to supply chain emissions reduction. Participants were selected based on a set of criteria: representation of different roles and levels of responsibility within the company's organizational structure and key involvement in their firm's sustainability initiatives. More specifically, decision-makers from different functions in the organization (namely, top management team members, sustainability, logistics, and R&D functions) involved in emissions-related measuring and reporting, planning and project management and technical development were involved to grasp individual managerial cognition of people with different backgrounds, roles and seniority. Lastly, in a few cases, the initial interviews made it clear that we needed additional data; therefore, additional respondents were invited for further interviews. Details regarding key informants are provided in Table 6.

***Table 6**: Interview participants' overview*

#	**Interviewee's role**	**Function**	**Experience**	**Years in the firm**
1.	Procurement and Purchasing Director	Procurement and Purchasing	27	10
2.	Procurement and Purchasing Manager	Procurement and Purchasing	10	7
3.	Corporate Packaging Research Development and Innovation Manager	R&D	20	18
4.	LCA and Product Sustainability Specialist	R&D	9	9
5.	Sustainability Operations Project Specialist	Sustainability	5	2
6.	Sustainability Advocacy Specialist	Sustainability	3	3
7.	Internal Logistics Manager	Logistics	32	29

8.	Head of Logistics, Inventory, Traceability, Sales Operations Processes	Logistics	12	11
9.	External Consultant and Board Member	Board	36	21

The interview protocol consisted of two parts: one explored the interviewees' role within the organization, individual-level values and the priority they assigned to environmental issues in respect to other business issues, and whether they perceived tensions and how they reacted to these. The second part involved organizational-level questions about actions the organization had taken to reduce supply chain emissions, leadership behaviors and decision-making guidelines, and the perception of tensions emerging among different functions in the firm or actors in the supply chain. Figure 11 builds on the conceptualization by Carter et al. (2015), which displays different levels of theory and analysis that characterize supply chain management phenomena, and shows the two levels which are touched upon in this research and interview guide. Finally, each interviewee was asked to think of one shift in practices or strategies that could speed up their process towards the net-zero goal. A more detailed version of the interview guide is provided in Appendix A. To guide the number of interviews included in this study, we followed two criteria: first, we aimed to include relevant informants; secondly, we stopped data collection as we were not gaining additional insights (i.e., theoretical saturation).

A total of 9 semi-structured interviews – lasting between 45 and 90 minutes - have been collected, electronically recorded with participants' permission, and transcribed. Most interviews are collected online and, for interviews collected on site, the facility tour became part of the data collection effort. Finally, to complement available information, we combine these primary sources of evidence with notes taken during the meetings and additional secondary data, such as internal documents and presentations, and publicly available reports and websites. This design allowed the researcher to capitalize on triangulation, combining different types of data from multiple sources (Pagell & Wu, 2009).

To increase data reliability, secondary data sources complemented the interviews and site visit. For triangulation, we used information coming from the company's website (i.e., the company's presentation in terms of mission and vision, its strategic development plan, and sustainability reports) as well as internal documents, presentations, and e-mails that were shared with the research team by interviewees.

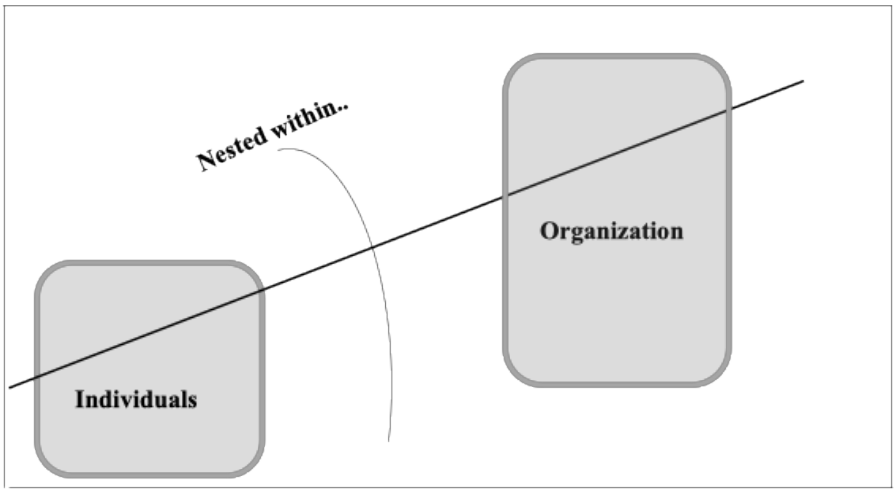

***Figure 11**: Levels of analysis of the research*

Data analysis

All interviews were initially conducted in Italian, because the study was conducted in Italy; therefore, after the transcription process, the interview transcripts were translated into English. A colleague who is fluent in both Italian and English then double-checked the correctness. During data analysis, we followed the steps suggested by Gioia et al. (2013): the analysis phase started with first-order coding of meaningful concepts from each interview and was facilitated by the software NVivo. Second-order themes were then derived by connecting various first-order themes. Lastly, the researchers looked for patterns across interviews to group themes into broader aggregate categories. This step led to the generation of a data structure, which served as the basis to develop propositions around factors shaping firms' ability to manage tensions in supply chain emissions reduction. Examples of quotes, accompanied by the interviewee's role and interview number, together with the derived categories, corresponding subcategories, and exemplary quotes are presented in Table 7.

Findings

In the following section, we first present an account of organizational factors that characterize organizations that are effective in reducing their supply chain emissions, before we describe how managers in different functions perceived and responded to paradoxical tensions surrounding supply chain emissions reduction goals. Fig. 7 displays the data structure, showing the emergent 1st-order categories (left) that generated the 2nd-order themes (center), which we distilled into two overarching dimensions (right) referring to the two levels of analysis here investigated.

***Table** 7: Data structure: coding and conceptualization process*

In vivo quotes	First order concepts	Second order themes	Overarching dimensions
"Our leadership has always made it clear that we are a company with a purpose - not to be the best in the world, but to be the best for the world." (#3) "The meaning of the company is its missions, to create a good life for all through beauty, ethics and sustainability. The product and everything else are tools." (#9)	Having a sustainability-oriented mission and purpose	Strong leadership commitment to sustainability issues	Organizational-level enabling factors
"In the majority of situations, we prefer a supplier that is more expensive but more sustainable." (#2)	Assigning economic resources for the firm's sustainability agenda	Adequate allocation of resources	
"As a company, we have a target of reducing by 55% our emissions by 2030. To do so, we support other functions with our technical and normative knowledge in defining what initiatives they can undertake and we accompany them in the implementation." (#5)	Having a dedicated organizational function with technical and normative competences		
"We have a platform that allows us to measure our suppliers' sustainability." (#1) "We have published a sustainability strategy along decarbonization, circularity, biodiversity and water. We have set objective targets that guide our investments and growth strategy." (#9) "At the beginning, it was my opinion against someone else's; now, with numbers and evidence, discussions are much more constructive and colleagues from other functions […] understand our point more easily. (#3)"	Establishing procedures and tools for objective measurement of sustainability dimensions	Decision-making guidelines based on objective measurement	

"The sustainability criterion weights 20% of our evaluation and it is balanced with reliability and quality. Other conditions being equal, we always prefer the supplier with the highest sustainability score, or the B Corp supplier over non certified one." (#2)	Formally including sustainability criteria in suppliers' selection		
"I realized sustainability has to be based on functionality and data. You can't make something ultra-light and fantastic if it breaks and becomes waste." (#3)	Framing sustainability as a set of technical choices	Paradoxical managerial cognition inside the organization	Individual-level cognitive framings
"I explain to suppliers that this [implement initiatives to reduce emissions, track progress and report] is a journey they have to do […] because it brings value to their firm." (#2) "*Assimilating this way of thinking* helped me so much in my professional and personal growth; it is something I deeply feel and believe in." (#1)	Framing sustainability as value, not cost		
"When I need to transfer to our suppliers the concept of having a good impact on the environment, I do not struggle at all." (#1) "It seems so obvious to share [this way of thinking] with suppliers." (#1) "In our last meeting, I asked to our main transport provider to have an electric truck on the route they cover for us daily. They have realized that we are activating all sorts of [more sustainable] alternative suppliers and solutions and they finally agreed to further investigate this idea." (#8)	Engaging supply chain partners in sustainability issues	Paradoxical managerial cognition across the organization's boundaries	

Organizational culture, leadership behaviours, and decision-making guidelines

Across all interviews, sustainability emerged as a foundational element of the case-company organizational culture. Interviewees repeatedly described sustainability as "part of who we are" and as a shared identity that guides everyday decisions. This cultural orientation was seen as the outcome of a long process of internal socialization, which started first with the development of an ethics chart for the firm and was later substantiated with the decision to apply for the B Corp certification. Such certification was obtained in 2016 and renewed in 2023.

Leadership behavior was widely recognized as a critical driver of the company's sustainability trajectory. Respondents highlighted the consistent and visible commitment of the top management team, both in how corporate leaders linked sustainability to the firm's long-term strategy and in how they took part in periodic meetings with different functions regarding the topic. "*The crucial element to me was seeing that the firm wanted to invest resources and dedicate managers' time to build and acquire the necessary knowledge. It infused a sense of responsibility and trust. First, this helped with the B Corp Certification; now it is necessary to attain our development strategy*" *(*Procurement and Purchasing Director, #1). Moreover, the leadership team consistently communicates that sustainability is directly tied to the company's purpose. A senior manager stated, "*Our leadership has always made it clear that we are a company with a purpose - not to be the best in the world, but to be the best for the world*" (Corporate Packaging Research Development and Innovation Manager, #3). Similarly, one board member stated that "*the meaning of the company is its missions, to create a good life for all through beauty, ethics and sustainability. The product and everything else are tools*" (External Consultant and Board Member, #9).

In 2023, the company launched its long-term development strategy based on four pillars: decarbonization, circular economy, biodiversity, and water. The document formalizes quantitative and qualitative goals for each pillar and ensures that all functions are aligned with the company's priorities. Regarding decarbonization, the company aims to reach net-zero by 2050 and to reduce emissions per kilogram of product by 55% by 2030. Moreover, the document serves as a tool to reinforce requests and clarify motives towards actors in the supply chain.

The company, however, also aims at reaching half a billion euros in revenue within the next five years. As noted by an interviewee, the goals of reducing supply chain emissions and of growing steadily generate tensions: "*in order to have zero emissions, we should shut down the firm. What we can do is to lower emissions to the minimum, with respect to what we aim to achieve*" (Procurement and Purchasing Manager, #2). Leadership, therefore, plays a dual role: on one side, it sets growing directions and, on the other, it embodies sustainability through daily behaviors and periodic statements. This commitment is mirrored in how sustainability targets are integrated into business

plans and functional decision-making guidelines, signaling to the organization that sustainable practices are part of performance expectations. Such a commitment eases the pressure on cost and the perception of tensions between environmental and economic goals.

Cosmetics has also codified sustainability principles into formal decision-making guidelines and measuring tools, transforming commitments into measurable processes. Procurement and R&D for product and packaging provide the clearest examples of this institutionalization. Managers described a structured approach in which sustainability is systematically evaluated through predefined criteria and quantitative metrics. The R&D team, for instance, largely relies on Life Cycle Assessment (LCA) evaluations of alternative packaging materials or ingredients. As one R&D specialist explained, "*the LCA tool allows us to decide based on numbers. Sometimes, you don't like the numbers you see or they are not what you – or other departments – were expecting. Yet, this helps us avoid emotional or aesthetic bias*" (LCA and Product Sustainability Specialist, #4). Thus, the large adoption of measurement tools and metrics enables the translation of sustainability values and commitment into day-to-day operational decision-making. They also reduce tensions between different functions by providing objective criteria, as can be seen in the following example. A marketing-related dispute about cellulose pulp packaging was resolved through objective evidence rather than opinion: "*marketing wanted a cellulose pulp packaging because it is generally perceived as sustainable by consumers. However, the selected material was made by a firm that did not use energy from renewable sources and required long transportation. We proved with data that it was not the best solution in terms of environmental impact, and the project was dismissed, even though creative departments wanted to go for it*" (Corporate Packaging Research Development and Innovation Manager, #3).

To further enhance alignment on environmental priorities among differing performance objectives, an intra-departmental team was created with the goal of bringing together people to engage in sustainability projects, bring and develop ideas, share best practices among different functions, and spread awareness. As commented by one interviewee, "*It's not just about the sustainability office. This team helps everyone understand that sustainability belongs to all of us*" (Sustainability Operations Project Specialist, #5). Communication, training, and participatory initiatives are needed because such a mission, values, and targets represent a cultural change, and a cultural change takes time. That is, it ultimately depends on individual decision-makers and how they embrace sustainable practices in their routines and daily activities. A purchasing manager commented, "*You cannot force people to change their habits overnight—it's a cultural matter. At a corporate level, the firm does a lot; but in the end, we employees are the firm, the people that make it up*" (Procurement and Purchasing Manager, #2).

Managerial cognition and responses to paradoxical tensions

Across the interviews, managers at *Cosmetics* displayed different approaches through which they made sense of sustainability and the tensions surrounding supply chain emissions reduction. While all respondents recognized value in the company's sustainability orientation, they differed in which tensions they perceived and how, as well as in the way they acted upon them.

A first group of managers displayed a more pragmatic orientation towards sustainability, emphasizing win-win conditions of cost efficiency and environmental impact reduction, or highlighting situations where they adopted an "either-or" approach, dismissing sustainability indicators in favor of cost KPIs or service level KPIs. These individuals perceive sustainability as strategically valuable but economically contingent; they legitimize it as long as it remains aligned with financial and operational performance. Examples of this framing can be found in the Procurement and Purchasing team as well as in the Supply Chain & Logistics function.

As one manager admitted, "*In some marketing projects, we need to work with foreign, distant suppliers to meet target costs; in Italy, we wouldn't find anything, not even close to the target. It's not ideal, but sometimes it's necessary. Also, the overall impact of marketing-related choices is small with respect to the choices we make regarding our core products, as volumes are very differen*t" (Procurement and Purchasing Manager, #2). This manager acknowledges the desirability of sustainability, but treats it as one criterion among others when making decisions in light of constraints. We interpret this as an "either–or" response to paradoxical tensions, shaped by situational flexibility.

The logistics function faces tensions between environmental impact and costs, service level, as well as technological and infrastructure availability. One manager, explaining the organization of product flows between the company's main site and its distribution hub, commented: "*Every day, two full trucks leave from here to our distribution hub; but we also ship directly from third-party manufacturers to the hub to avoid extra transport and related emissions*" (Internal Logistics Manager, #7). This comment illustrates an effort to optimize routes and loads as a solution to reduce both costs and emissions.

To balance tensions between service level, costs, and environmental impact, also in light of available solutions and infrastructure, dedicated deliveries in the area surrounding the company's headquarters have been implemented. "*We have started relying on smaller logistics service provider who are building, thanks to our commitment of doing business together, a fleet of electric vehicles – costs are higher but acceptable as this solution allows us to ensure our KPIs in terms of service level*

while reducing transport-related emissions" (Head of Logistics, Inventory, Traceability, Sales Operations Processes, #8). A few initiatives, on the other hand, are not progressing due to a lack of agreement between logistics and commercial functions: to expand the area of deliveries performed with electric vehicles, a renegotiation of service KPIs would be needed, as the autonomy of these vehicles would not guarantee the current service level. At this point, commercial departments have not decided yet whether to penalize the service lever; therefore, this type of emissions reduction initiative in the logistics field remains hard to scale in broader geographical areas. Beyond transport and route optimization, both logistics professionals framed sustainability as an issue requiring visibility across the entire supply chain. "*Our goal is to give evidence of what happens from purchasing to disposal; we are working with our third-party logistics partner to get data on what their internal operations are*", one manager explained (Internal Logistics Manager, #7). The logistics department remains grounded in efficiency and process optimization, and among interviewees, it appears to be the function that experiences tensions among competing demands the most. Logistics managers show a pragmatic understanding of sustainability as an operational tension that must be managed rather than solved. This awareness sets the stage for more integrative, data-supported decisions and requirements to be transferred also at the organizational level.

Overall, these managers recognize the organization's sustainability mission and values but stick to business performance rationality; thus, they respond to paradoxical tensions either by optimizing (i.e., win-win conditions), compromising (i.e., balancing performance targets), or selectively integrating (i.e., preserving financial and operational legitimacy, while supporting incremental environmental progress).

A second group of managers viewed sustainability goals and business performance as interdependent elements of the same system. These interviewees could rationalize the competing demands they were exposed to in their different roles, and frame the multiple sides of a paradox as mutually reinforcing and inherently complex. In this cognitive, unintentional process, managers frequently mentioned the support of the large adoption of technical and scientific tools and metrics, as well as their backgrounds. This orientation was mostly visible among R&D and Sustainability professionals, who frequently described sustainability as an analytical problem that required understanding multiple, interconnected variables.

Interviewees from the R&D team described sustainability as an integral dimension of product and packaging development. They revealed a process of constant reconciliation between product performance, packaging design aesthetics, costs, and environmental impact, framed through professional expertise and precise empirical evaluation rather than intuition. A manager emphasized

that the team's approach to eco-design and packaging development had evolved toward scientific rigor and measurability: "*My approach has always been very analytical, and I think it comes from my university studies, which I did abroad. So, when I came here, I realized sustainability has to be based on functionality and data. You can't make something ultra-light and fantastic if it breaks and becomes waste*" (Corporate Packaging R&D and Innovation Manager, #3). This orientation toward evidence and verification reflects a mindset where technical soundness is treated as inseparable from environmental responsibility. Similarly, a Life Cycle Assessment specialist reflected on the importance of objective measurement, connecting it to how her educational background helped her manage the complexity of sustainability issues: "*In sustainability, transparency is fundamental, because it is based on data that needs to be reliable before being interpreted. I think this approach comes from a very comprehensive view of ecosystems that I got from my university studies in natural sciences; it gave me a holistic perspective"* (LCA and Product Sustainability Specialist, #4).

On the same line, a member of the Sustainability function highlighted the importance of data accuracy and the need for functions to be responsible and accountable for what they do and the data they provide. "*At first, many colleagues only knew they had to transfer to us some data that we were asking for, but they didn't really understand why. Now we have established a data governance structure, defining responsibility and accountability figures as well as informed and consulted people. This eases our effort in data management but also increases the commitment of leadership teams across functions, transferring the message that environmental impact is a shared responsibility*" (Sustainability Advocacy Specialist, #6).

Most managers in this group also described personal values as deeply aligned with the firm's mission, as explicated in the following quote: "*My daily work here is consistent with what I believe in—ethics and transparency are part of who I am*," noted an LCA and Product Sustainability Specialist (#4). Similarly, another manager commented about his personal interests and educational choices and how they are reflected in the job he does at *Cosmetics*: "*I developed a passion for environmental issues and decided to make them my job. Today, what moves me in my role is the chance of making even a small difference and changing the world for the better. I feel here we are motivated and encouraged to pursue this goal*" (Sustainability Operations Project Specialist, #5). This strong identification reinforced their resilience toward contradictions, as sustainability and the reduction of environmental impact are not simply a task but an expression of personal and professional coherence.

Responses to intra-organizational paradoxical tensions

Scientific reasoning, the adoption of technical tools, and objective data helped managers rationalize and visualize the systemic consequences of decisions and thus manage contradictions among different functions more constructively. Throughout the interviews, various examples of tensions among departmental competing demands emerged, which were resolved by leveraging objective analyses of the environmental impact of different solutions. The R&D team acknowledged persistent tensions between market demand and environmental considerations, such as the use of black or complex-colored packaging, where aesthetic choices often conflicted with recyclability requirements. A second example regarded a project to reduce emissions from raw materials: the R&D team proposed different options with relative indicators of performance and environmental impact, which were later discussed with the procurement function, "*because oftentimes, sustainability brings higher costs, right?*" (Procurement and Purchasing Manager*,* #2). Anyhow, resource allocation by the company's leadership and a formal inclusion of sustainability criteria in the supplier selection matrix allow the Procurement and Purchasing team to pursue emissions reduction goals over cost efficiency. The approach is clearly synthesized by the words of the Procurement and Purchasing Manager (#2): "*In the majority of situations, Cosmetics prefers a supplier that is more expensive but more sustainable. We could buy packaging bottles from China and pay them half the price, instead we buy packaging bottles from a firm located 6 kilometers from our production site – and we are already working on a project with the supplier: they will install photovoltaic panels and provide an electric truck for this 6km route to further reduce transport impact*".

These professionals often mediate competing priorities across departments, using scientific reasoning and evidence to reach integrative solutions. Their approach to balancing competing demands is explained by the LCA and Product Sustainability Specialist (#4): "*We always try to find a balance: we are a production reality and we need to create products and sell them. Still, our principles are largely sustainability-oriented, so we always look for the least impactful solution, as long as we can have a product that is high performing, with proper packaging, and that is accepted on the market. Otherwise, we may have done the most sustainable product, but after transporting it to stores, it is not sold, or the packaging breaks because plastics were too thin, then it becomes waste, and all the effort is lost*". Beyond technical challenges, a broader cultural change within the company was highlighted, which was supported and legitimized by an extensive use of objective measurement. A manager noted that sustainability discussions had shifted from persuasion to collective learning. "*At the beginning, it was my opinion against someone else's; now, with numbers and evidence, discussions are much more constructive and colleagues from other functions, who also look at costs or market trends, understand our point more easily*" (Corporate Packaging R&D and Innovation

Manager, #3). This professionalization of sustainability - anchored in shared data and methodology - appears to have strengthened both the credibility and the internal influence of the R&D function.

In sum**,** scientific and technical reasoning acted as an enabler of paradoxical cognition**,** providing the analytical means to comprehend and integrate multiple and competing dimensions of sustainability and business performance. These managers responded to tensions through integration and learning, turning tensions into innovation and uncertainty into collective and objective knowledge.

Managerial cognition in boundary-spanning roles

The procurement and purchasing team at *Cosmetics* plays an active role in spreading the firm's environmental strategy throughout actors in the supply chain and in managing suppliers' sustainability. The team has developed a clear procurement and purchasing policy, as well as a habit of collaborating with suppliers through supplier engagement and supplier development initiatives. This approach to external relationships stems not only from formal reporting and compliance requirements but mostly from individual motivation and concern for sustainability issues. This is clearly synthesized in the words of the Procurement and Purchasing Director (#1): "*When I need to transfer to our suppliers the concept of having a good impact on the environment, I do not struggle at all. Assimilating this way of thinking helped me so much in my professional and personal growth; it is something I deeply feel and believe in, and it seems so obvious to share it with suppliers*". Moreover, the team perceives their request as legitimate because pursuing sustainability goals or getting sustainability certification should bring value to the supplier firm itself. As clarified by the Procurement and Purchasing Manager (#2): "*I explain to suppliers that they are not doing any sustainability efforts because Cosmetics is asking them to; this is a journey they have to do because they believe in it and because it brings value to their firm*".

While keeping the perspective of the buying firm, managers at *Cosmetics* also recognized suppliers' struggles and tensions in terms of cost, knowledge, and time needed to pursue sustainability goals and align with their standards, especially for small and medium suppliers. Therefore, the company organizes webinars and informational events to engage and educate suppliers on sustainability issues. However, in line with its commitment to reduce Scope 3 emissions by 55% by 2030, the company is ready to reduce its commercial relationship with all those suppliers who are not aligning with the company's goals and requirements.

Overall, managers who frame sustainability goals and business performance as interdependent elements and personally believe in reducing environmental impact as a goal that brings value are keener to engage with suppliers, negotiate, and balance trade-offs. Furthermore, these managers

personally care about disseminating to partners in the supply chain an organizational culture of sustainability. This resulted in a positive spillover effect, with 27 suppliers in *Cosmetics*' supply chain following the company's example and obtaining the B Corp Certification after an in-depth assessment.

To sum up the findings, Table 7 highlights organizational-level elements and individual-level cognitive factors that enable management responses to paradoxical tensions, in the context of implementing a series of initiatives to decarbonize *Cosmetics'* supply chain.

Discussion and implications

This study has explored how organizational and individual cognitive frames shape managerial responses to tension between cost, service, quality and environmental impact in sustainable supply chain management. By combining insights from paradox theory with rich qualitative data, the findings show that managers do not simply react to competing demands by attaining either at cost, performance, or sustainability; rather, they interpret and frame competing demands in light of organizational factors and manage emerging tensions accordingly. Our findings partially align with previous studies (Wright & Nyberg, 2017; Xiao et al., 2019) as our in-depth case study of a multinational company shows that, in practice, some functions still perceive economic and service goals as superior to environmental ones, thus adopting an "either-or" type of approach to sustainability issues. This response strategy was particularly common among logistics and supply chain managers, who are still struggling to scale sustainable transport solutions while maintaining service levels as agreed with customers and ensuring economic viability. Differently, this was not the case for the procurement and purchasing team. While previous literature identified the latter function as one of those mainly suffering the sustainability vs. cost tension (Eggert & Hartmann, 2021; Xiao et al., 2019), in this case-study strong leadership commitment to sustainability issues, followed by resource allocation for "smart buying" (i.e. buying the best product in terms of quality and sustainability, at the best available price), eased the tensions perceived by purchasing managers. The purchasing and procurement team in this case study very rarely needs to compromise or suppress environmental indicators in favor of lower costs. Instead, buying options that are very convenient but do not meet quality and sustainability criteria, do not even make it to the pool of options to be evaluated; this further reduces the perception of existing tensions. This leads to the first proposition:

Proposition 1: Organizational factors – namely a strong leadership commitment to sustainability issues, together with adequate allocation of resources and clear decision-making guidelines based on objective measurement – alleviate managerial perception of tensions, easing a shift from adversarial "either-or" to paradoxical "both-and" approaches to tensions management.

Previous literature suggested that more holistic organizational frames also strengthen managerial cognitive framings of sustainability (Benkert, 2020). Across all functions, managers exhibit a nuanced awareness of the coexistence of multiple, sometimes conflicting demands - commercial, operational, financial, and environmental - and respond to them through integration, compromise, and learning rather than suppression or avoidance. Because management approaches to tensions result from individual level cognitive frames and sensemaking (Carmine & De Marchi, 2023; Cichosz et al., 2025; Joseph et al., 2020), these individual-level responses form the foundation for understanding how managers at *Cosmetics* make sense of paradoxical tensions in pursuit of supply chain decarbonization. At the individual level, many interviewees described a move from personal ethical or reputational interpretations of sustainability issues toward a technical–scientific framing based on empirical data, objective measurement tools, and continuous improvement. Such a shift was enabled by investments in transparency platforms, data access and measurement tools, as well as in human resource development and education in order to bring technical knowledge inside the company. This reframing reduces the perceived incompatibility between performance and sustainability goals (a classic *performing paradox*, such as aesthetic design versus recyclability; increasing costs versus low-emissions raw materials) and provides a background for paradoxical tensions to be framed as poles to be integrated rather than conflicting values. This acknowledgement becomes the context within which every business decision is evaluated.

Proposition 2a: A shift towards a paradoxical cognitive frame reshapes managerial reasoning, so that environmental objectives and impacts become the boundaries wherein business decisions are conceived and evaluated, rather than external constraints to be traded off against economic goals.

Moreover, empirical data and technical knowledge, together with objective measurement tools and indicators, become neutral reference points. Consequently, indicators of environmental impact are acknowledged with equal legitimacy as traditional business indicators, further spreading the shift towards a paradoxical cognitive frame among individual managers in different departments. Such a shift does not only ease the perception of paradoxical tensions by an individual manager, but it also builds a common ground through which conflicting demands that may emerge between departments can be mediated and balanced. This enables what Smith and Lewis (2011) conceptualized as *dynamic equilibrium,* where paradoxical tensions are continuously balanced through iterative interaction. This leads to the second part of the proposition:

Proposition 2b: When a managerial paradoxical cognitive frame spreads throughout functions, it can alleviate inter-organizational tensions and create the necessary space for managers to balance competing demands and manage paradoxical tensions within their roles.

As derived from previous propositions, managers who develop paradoxical framings and adopt "both-and" responses perceive sustainability as integrated with business performance; managers in boundary spanning roles also tend to convey such a frame to actors in the supply chain with whom they interact. Conversely, when sustainability is framed in "either-or" terms (i.e., as a trade-off against cost, lead time, or quality), it is followed by a suppression response that resolves paradoxical tensions by dismissing one pole of the tension (Xiao et al., 2019). Instead, managers in a buying company who embody a "both–and" mindset are keener to engage suppliers, negotiate and balance trade-offs, as well as disseminate an organizational culture of sustainability. As the findings of this case show, a strong leadership commitment, supported by technical and scientific knowledge and tools grounded in objective data, generated the conditions for individual managers to shift towards paradoxical cognitive framings and integrate tensions surrounding supply chain emissions reduction. In turn, managers felt at ease and were keener to spread the organization's vision and engage suppliers. As a result, 27 suppliers in *Cosmetics*'s supply chain followed its example and filed the assessment for the B Corp Certification. We thus propose:

Proposition 3: *Managers who hold paradoxical cognitive frames are better able to transfer sustainability priorities to supply chain partners, facilitating collaborative relationships and enabling the joint management of paradoxical tensions across organizational boundaries.*

Our findings reveal implications for advancing theory in sustainable SCM literature and demonstrate the value of applying a paradox perspective to SCM literature. We argue that this perspective allows for a greater understanding of how paradoxical tensions, which can hardly be removed in the sustainability context, can be managed to integrate supply chain emissions reduction goals with other (traditional) business aims. Specifically, this study clarifies how organizational factors – namely leadership and top management team commitment, together with clear decision-making guidelines and tools – influence individual managers cognitive frames, which in turns impact how managers perceive and respond to sustainability-related paradoxes. First, it highlights how such framings are developed in light of and accordingly to organizational culture (Proposition 1). Secondly, the study characterizes individual-level paradoxical cognitive framings in the context of emissions reduction, suggesting that environmental objectives and impacts become the boundaries wherein business decisions are conceived and evaluated, rather than external constraints to be traded

off against economic goals (Proposition 2a). Again, the more this framing spreads in the organization, the more it alleviates inter-organizational tensions and creates a common ground for managers to balance competing demands (Proposition 2b). Lastly, we find that cognitive frames also influence tendency and ability of managers to transfer and communicate beyond the walls of the organization, with actors in the supply chain (Proposition 3). While prior paradox research in SCM examined either individual cognition (Mies et al., 2025; Miron-Spektor et al., 2018; Xiao et al., 2019) or organizational design (Jarzabkowski et al., 2013; Joseph et al., 2020), this study illustrates their interdependence within a single case. The juxtaposition of these two levels also responds to previous calls for research into the issue (Benkert, 2020; Wright & Nyberg, 2017). Therefore, we advance knowledge on managerial cognitive framings in the sustainability context, more specifically on paradoxical cognitive frames in the context of reducing supply chain emissions.

While our study is among the first to empirically apply a paradox perspective on sustainable SCM issues, we also contribute to the general literature on paradoxes and cognitive frames (Hahn et al., 2014, 2018; Schad et al., 2016). Researchers in this field have long highlighted the existence of different cognitive frames and conceptualized their influence on managerial responses to tensions (Preuss & Fearne, 2021). Cognitive frames were studied as a fixed and given feature of individuals. However, an important influencing factor, the organizational culture as manifested through leadership behavior and commitment, tends to have been overlooked. Here, we lend empirical support to the conceptual work of Benkert (2020) and Preuss & Fearne (2021) by highlighting the relevance of organizational factors in shaping managerial cognitive frames.

Limitations and future research

This research presents some limitations, which also offer opportunities for future research. Overall, the study assesses a single organization based in Italy operating in the beauty and cosmetics industry. Results may not be generalizable to other industry settings for different reasons: first, the industry is characterized by high operating margins, thus easing tensions related to costs and resource constraints; second, the case company has developed its supply chain so as not to be heavily dependent on a few dominant suppliers of critical material - except for a residual share of components. This provides greater flexibility in supplier selection and access to viable sourcing alternatives, ensuring the opportunity to evaluate suppliers also based on sustainability performance. Future research should seek to address the research objective by considering firms operating in different industries, also in light of sector-specific legislation. This could improve the external validity of current findings and lead to new discussions.

Secondly, the company is a leader in setting sustainability targets and implementing related-strategies, and has the specific goal of reducing 55% of emissions by 2030, both within direct operations and indirect supply chain emissions. While the selection of a best-in-class organization was part of the research design, as the emphasis is on understanding how organizational and managerial features shape companies that are making progress in the supply chain emissions realm, these explicit commitments create a unique organizational cognitive frame. Therefore, propositions regarding the organizational factors are hardly generalizable to other companies. Moreover, this case-selection results in a scant focus on unresolved tensions that remain, highlighting an interesting avenue for future research.

Another limitation is inherent in the single case study methodology, where a variety of topics and variables may emerge due to extensive data collection from a variety of sources. A second limitation related to the methodology regards the risk for the researcher to insert biases in the data analysis process; in this regard, a variety of measures to prevent it have been taken (see methodology section for details).

Finally, this research does not directly assess upstream suppliers' perspectives on the issue of supply chain emissions reduction, which represents a significant limitation in the analysis of Scope 3 emissions. While the perception of suppliers and logistics service providers' experience of tensions and difficulties was investigated, the perspective remained that of the focal firm. This omission is critical because suppliers constitute a pivotal node in the literature on sustainable supply chain management; moreover, it excludes potential considerations of power dynamics, different operating margins as well as differing reporting requirements (based on geographical location, sector, and firm size) that could influence the perceived relevance of the emissions reduction topic and in turn company's commitment. Further studies may go beyond the focal firm to investigate suppliers' perspectives on enablers and barriers of emissions reduction when working with companies with highly ambitious environmental targets and reporting and measurement requirements.

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V. CONCLUSION

Summary of the findings

This dissertation tackles the reduction of supply chain emissions, a topic that has taken center stage on corporate and policymakers' agendas in recent years, capturing the attention of both academic literature and industry practice (Ellram & Tate, 2025; Wieland & Creutzig, 2025; World Economic Forum, 2021). Specifically, this dissertation represents an effort to understand how supply chain management processes, goals, and metrics can be revised in light of the need – and formal obligations coming from the Paris Agreement on Climate Change - to reduce environmental impact. A genuine top management commitment to net zero will affect not only everyone in the organization's goals, metrics and compensation, but it will also necessarily include supply chain, thus requiring a much more intense and systemic effort (Ellram & Tate, 2025). As a consequence, the phenomenon has been framed as a multi-level one. Specifically, a triadic structure proxies for supply chain mechanisms, as triads are the minimal configuration that reveals cross-link effects (how one dyad conditions another one) and node effects (how actors' positions/roles matter), providing a tractable gateway to analyzing broader dynamics. I investigate the research questions of this dissertation with a multi-method design, that connects a systematic literature review on inter-organizational triads in supply chain management (Essay 1) with two qualitative empirical studies: an inductive grounded-theory investigation of a brand manufacturer & retailer–OEM–logistics service provider (LSP) triad in the household appliances sector (Essay 2) and a single-firm case study in the beauty and cosmetics industry (Essay 3).

Essay 1 systematically reviews to consolidate and structure the fragmented logistics and supply chain management literature dealing with inter-organizational triads. It distinguishes triadic structures, such as two-tier manufacturing triads, three-tier triads, and service/logistics triads. The review also identifies five dominant thematic clusters (interactions and dynamics, nature of relationships, servitization and outsourcing, governance and control, innovation), alongside the principal theoretical lenses (social capital theory, agency theory, and the relational view) and methods. The review also exposes limited attention to sustainability-oriented and reverse-flow contexts and calls for research on how triadic structures and inter-organizational dynamics shape environmental outcomes.

Essay 2 explores how supply chain decarbonization efforts progress - or stall - through multi-level alignment in a logistics triad composed of a brand manufacturer & retailer, an OEM, and an LSP. Across functional (day-to-day operations), organizational (strategic priorities and resource allocation), and supply-chain (inter-organizational) levels, alignment is strongest when environmental initiatives deliver simultaneous benefits in terms of efficiency or cost advantages.

Instead, when regulatory signals are ambiguous or when external customer pressure is not matched by collaborative development or internal strategic prioritization, misalignment emerges, slowing implementation of initiatives. Data and measurement challenges hamper the identification of spaces for improvement, as well as the definition and cascading of Scope 3 targets across partners. The study articulates process mechanisms - such as shared metrics, iterative target-setting, and inter-organizational coordination—that enable moving from organizational commitments into operational practices and outcomes within the triad.

Lastly, Essay 3 investigates how organizations that are effective in reducing their emissions look like, internally and throughout their supply chain, as these are the organizations that are equipped to also address the intrinsic competing tensions surrounding supply chain emissions reduction. The third essay adds a cognitive account of how individuals within organizations cope with paradoxical tensions inherent in supply-chain emissions reduction (e.g., growth vs. decarbonization; service level vs. environmental performance; short-term cost vs. long-term investment) and how organizational elements influence their sensemaking. The case study shows that leadership behaviors and explicit decision rules grounded in objective measurement foster an organizational context where managers adopt paradoxical cognitive frames and recast tensions as technical and design challenges. These frames travel through boundary-spanning roles to suppliers, enhancing collaboration, supplier certifications, and diffusion of measurement practices. The study details how organizational scaffolding (purpose, strategy, resource allocation, KPIs) and individual cognition jointly generate a managerial and organizational cognitive frame that leads to "both-and"-type responses (i.e., integrating different facets of tensions, rather than dismissing one objective) that sustain progress on Scope 3 supply chain emissions reduction.

Theoretical contributions

The dissertation offers some theoretical contributions to logistics and supply chain management literature, particularly at the intersection of the research areas addressed in the essays. First, it provides an overview of the current state of inter-organizational triadic studies, laying a foundation for future research. The review reframes triads as a necessary unit of analysis for theorizing broader supply chains and extends the agenda of triadic research toward sustainability-relevant contexts.

Second, the dissertation extends multi-level research in supply chain management (Carter et al., 2015) by integrating functional, organizational, and triadic levels of analysis into an alignment mechanism that explains how the interplay of such levels allows translating formal commitments into positive practices. The findings identify conditions under which alignment is facilitated (coincidence

of economic and environmental benefits; regulatory clarity; shared metrics and data architectures) and hindered (regulatory ambiguity; external signaling not matched by internal prioritization; data and traceability gaps). This expands predominantly firm-level studies of emissions reduction by investigating how intra- and inter-organizational interactions shape environmentally positive outcomes. The study creates opportunities for future research to explore boundary conditions and mechanisms that could ease alignment inside organizations and among actors in the supply chain to boost impact of sustainable supply chain management initiatives.

Third, the dissertation further frames the conditions that hinder alignment as tensions and extends some aspects of paradox theory. Specifically, Essay 3 builds on cognitive framings and on the concept of paradoxical frames (Hahn et al., 2014; Preuss & Fearne, 2021) to clarify that an approach to making sense of paradoxical tensions is not innate; rather, it is influenced by individual values and background, experience, and, most of all, by the organizational context. Specifically, leadership commitment and behavior, decision-making guidelines based on objective data and scientific reasoning, together with a purpose-driven culture, foster a shift towards paradoxical frames whereby managers can make sense of competing demands as an intrinsic part of their job and navigate them without collapsing them into trade-offs. Moreover, the propositions articulate how these frames propagate towards actors in the supply chain (suppliers, in the case study in this dissertation) through boundary-spanning roles, thereby linking micro-foundations (i.e., individual cognition) to inter-organizational outcomes.

Taken together, the essays contribute to logistics and supply chain management literature by reaffirming triads as a necessary analytical unit for diffused phenomena; to sustainable supply chain management by explicating multi-level alignment mechanisms for supply chain decarbonization; and to paradox scholarship by specifying organizational and cognitive enablers of managerial responses to paradoxical tensions in supply chain emissions reduction.

Managerial implications

This dissertation also offers managerial insights and guidance regarding strategic approaches for firms seeking to reduce supply chain emissions. The three essays stem from a partnership between the University and a manufacturing firm in the household appliances industry, which led to the funding of an industrial PhD scholarship. The need to tackle GHG emissions emerged early in the initial discourses with managers at the firm, who signaled increasing pressures from customers and policymakers but also difficulties in meeting expectations and requirements. The two empirical research works that followed were developed based on extensive conversations with the managers who took part in the interviews, as well as on visits to manufacturing plants and headquarters, which

provided precious insights that sometimes went beyond the scope of each research piece. Thus, managerial implications combine findings from the analysis of the data collected, with practical takes derived from direct experiences of managers. Moreover, the economic, geopolitical, and regulatory landscape - which underwent recursive shifts during the three years that accompanied the development of this dissertation – was quite frequently mentioned in the talks. When relevant to the scope of the investigation, specific contextual aspects were formally included in the findings and in the discussions; however, external influences and constraints are worth mentioning for the development of managerial implications referred to the overall findings of this dissertation. This section critically integrates results from the analysis performed in the three essays, practical managerial concerns, and external contextual factors.

First, logistics and supply chain managers should expand the perimeter of their evaluations and decision-making beyond the relationship with a single supplier at a time, and consciously govern triads in ways that exploit each actor's role and competencies. This may allow leveraging different actors' positions in the supply chain as well as intercept potential unexpected, negative consequences that propagate in the supply chain and that may not be visible when considering a single dyadic relationship. LSPs can aggregate volumes and standardize flows to optimize warehousing and transportation; buyers can adapt their KPIs and redesign flows from a variety of suppliers to optimize routes and loads while easing the burden of environmental impact vs. costs tensions; suppliers can further bring upstream their knowledge of design-for-environment requirements, shared KPIs they may have developed in collaboration with the buyer as well as tools for data collection, thus generating a positive spillover effect throughout the supply chain.

Second, progress depends on multi-level alignment. Managers and directors within various functions (i.e., procurement and purchasing, logistics and supply chain, product design and development, production) should translate environmental ambitions into function-specific targets and procedures to embed sustainability into their core operations. Where possible, prioritize "easy-win" initiatives that deliver both environmental and efficiency gains to accelerate adoption and foster alignment. Later on, sustainability stances need to be backed up with adequate and consistent resource allocation, which may also manifest in the design of aligned incentives both within firms (e.g., incentive-aligned procurement) and throughout the supply chain (e.g., active industry collaboration that fosters alignment of standards, when regulations fail to do so).

Third, knowledge of supply chain boundaries, as well as transparency and data availability, still represent a major drawback. To streamline the process of data collection at a corporate level, managers could spread ownership of data collection within the firm to generate a sense of shared responsibility for reporting requirements and goal attainment. At the supply chain level, tracking

environmental data (and emissions, specifically) requires data-intensive work and is heavily dependent on supplier collaboration. Closer supplier engagement, paired with the adoption of more sophisticated tools, may lend digital traceability and harmonized data. Finally, industry collaborations via research consortia can enhance transparency and foster unified standards for data collection, measurement, and reporting by ensuring that different entities in the supply chain (i.e., upstream and downstream) start working together. In a scenario characterized by ambiguous regulatory guidance, robust shared standards can prevent frustration feelings and decision paralysis.

Finally, leadership and top management teams that commit to emissions-reduction targets need to develop an organizational context that recognizes the existence of tensions and provides the tools that ease the process of tension management. Among these, access to data and objective measurement allows embedding sustainability in KPIs. In addition, leadership and top management team participation in environmental-related meetings and events reinforces responsibility and shared commitment, representing a key enabler to tensions navigation.

In sum, by integrating triadic structures, multi-level alignment mechanisms, and managerial cognition, this dissertation also offers a practical take for accelerating supply chain emissions reduction. The combined insights suggest that meaningful supply chain emissions reduction is achievable when the supply chain structure is made visible and governed, when organizational commitments are translated into multi-level procedures and shared metrics, and when leaders cultivate the cognitive capacity to embrace and manage paradox.

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Statement about usage of generative AI

Generative AI tools have been used in this dissertation for copy-editing purposes, in order to improve language and readability of existing author-created material. No wholly new content has been generated through the use of such tools.

VI. APPENDICES

Appendix A

Interview guide (Essay 2)

Part 1: General information about the interviewee (role, job responsibilities, department, professional background)

Part 2: In-role engagement with environmental issues

- Describe your understanding of the influence of your role/your department on your company's environmental impact?
- What are the main objectives of your department regarding the environmental impact of activities? Do you have any indicators (KPIs), and if so, how do you measure the environmental impact?
- Which other company functions or external companies do you interact with in carrying out your tasks? How do you interact with them?

Part 3: Decarbonization questions

Part 3a: Scope 1-related questions

- What initiatives, if any, is your company developing internally in terms of sustainability?
- Could you describe how your department operates to reduce the organization's emissions?
- Are you aware of any emission-related targets?
- Could you tell us about the main challenges, if any, you have encountered in this area?

Part 3b: Scope 2-related questions

- What initiatives, if any, is your company developing regarding energy production and consumption?
- Do you have any targets related to energy consumption (electricity, heating, etc.) and energy efficiency? Please share details and the progress made.

Part 3c: Scope 3-related questions

- What sustainability initiatives, if any, is your company developing externally, involving other companies in your supply chain? Any initiative specifically tackling supply chain emissions?
- Who are the key actors within your supply chain with whom you engage on sustainability issues? Can you share the companies' names and contact points?
- Could you describe your relationship with the partner during the implementation of the initiative? How significant is this collaboration in achieving your environmental impact reduction goals?
- What are the main challenges, if any, that you have encountered in this area?

Part 4: Regulations and reporting

- Are you aware of whether your organization produces sustainability disclosure (through the Global Reporting Initiative (GRI), Carbon Disclosure Project (CDP) or any other such initiative)?

- Are there any national/supranational (EU) policies or government incentives that have guided or driven your initiatives regarding emissions? How?

Appendix B

Interview guide (Essay 3)

Part 1: General Information about the Interviewee (role, professional background)

Part 2a: Individual Values and Cognitive Frames

- How do your personal values and principles influence your work activities, if at all?
- What role does environmental impact assessment—particularly regarding emissions—play in your decision-making? How would you compare it to other performance dimensions (e.g., price, quality, service)?

Part 2b: Tensions, Paradoxes, and Contradictions (Individual Level)

- Do you perceive tensions or contradictions between your own views on these priorities and those of colleagues from other business functions? How are such tensions managed or balanced, considering the organizational culture and context? Could you provide an example of a real situation?

Part 3: Organizational Background

- What initiatives for reducing environmental impact—and particularly emissions—are being developed in the company and in your supply chain?
- Could you describe the main challenges you have encountered in managing supply chain sustainability?
- From your perspective, what challenges do your suppliers face in meeting your sustainability standards?

Part 4a: Organizational Factors

- What is the company's rationale for implementing activities aimed at reducing environmental impact and emissions?
- What behaviors or actions by the CEO and top management have you observed regarding environmental challenges? For instance, statements, resource allocation, or other initiatives?
- What are the main performance indicators you use? How is sustainability performance incorporated into your KPIs?

Part 4b: Tensions, Paradoxes, and Contradictions (Organizational Level)

- In managing day-to-day operations, strategic or operational goals may sometimes come into conflict. How are such tensions handled at the organizational level? And along the supply chain?