

From supply chain learning to The Learning Supply Chain: drivers, processes, complexity, trade-offs, and challenges

Bruno S. Silvestre (Asper School of Business, University of Manitoba, Winnipeg, Canada)

Yu Gong (DDAR, University of Southampton, Southampton, UK)

John Bessant (University of Exeter, Exeter, UK)

Constantin Blome (School of Business, Management and Economics, University of Sussex, Brighton, UK)

Abstract:

Purpose: *The view that supply chain learning (SCL) has become a fundamental capability that supply chains must employ to innovate and improve their financial, technological, operational, environmental, and social performance is widely accepted. However, the SCL phenomenon is still understudied and not fully understood by scholars, decision makers, and government representatives. This article aims to make sense of the existing literature and to identify important research directions that require further attention.*

Design/methodology/approach: *This article reviews the diversity of SCL in the literature, proposes a typology of such a phenomenon, provides an overview of key articles in the literature, and identifies a series of recommendations for the future development of the field.*

Findings: *This article combines two fundamental dimensions from the literature (i.e., SCL driver and SCL network) to produce a typology of four types of SCL: Captive, Consortium, Selective, and Distributed.*

Practical implications: *The typology proposed here offers an important framework for supply chain decision makers to rely on when implementing SCL initiatives. The implications of each type of SCL offer a robust rationale for decision makers to adopt the most appropriate type of SCL or combinations of SCL types, given each situation. In addition, the typology supports policy makers in further understanding the SCL phenomenon and creating effective innovation, economic development and sustainability policies through supply chains.*

Originality: *This article offers a novel typology that we hope will help scholars to advance the field of SCL in order to understand this important phenomenon. There is no good/bad/better/worse SCL type in the proposed typology, but the critical element for the success of SCL efforts is the level of fit between the type of SCL, the type of knowledge to be created and diffused, and the outcome supply chains aim to achieve with that learning effort. In addition, we coin the construct of “The Learning Supply Chain”, which refers to a supply chain that learns constantly by employing all four types of SCL simultaneously.*

Keywords: supply chain learning, focal company driven learning, supplier driven learning, driver, supply chain learning network, “The Learning Supply Chain”, typology.

1. Introduction

Events in the last few years have posed unprecedented uncertainties and challenges to the practice of supply chain management. COVID-19, trade wars, political polarization, the invasion of Ukraine, to mention only a few, have largely changed the business landscape and the way supply chains must operate. This scenario prompted supply chain players to recognize that one of their major bottlenecks is the ability to learn from other players or collectively learn in partnerships (Hult et al., 2004; Aslan et al., 2022). Companies more than ever now realize they are required to learn new capabilities, together with their supply chain partners, to face the current challenges and the uncertainties of the future.

Supply chain learning (SCL) can be defined as the collective learning that happens among multiple supply chain players. SCL has been studied for over two decades now with increasing attention in recent years (Silvestre et al., 2020; Silva et al., 2023). Earlier, Nelson and Winter (1982) propose that inter-organizational or network-level learning is defined as bilateral and multilateral knowledge-sharing routines among buyers and suppliers that enable the recombination or transfer of new knowledge either within or between supply chains.

For example, Dyer and Nobeoka (2000) explore the knowledge sharing network of Toyota and find that strong network identity and coordination rules are needed to manage the multidirectional knowledge flows within the supply chain network and achieve the most effective learning outcomes. In a similar vein, Spekman et al. (2002, p. 42) suggest

that learning is a key component of supply chain competency, and that the supply chain can be seen “as a vehicle for gathering knowledge and learning”. Bessant et al. (2003) is among the first studies to formally propose the concept of SCL. They identify the stages of SCL (i.e., set-up, running and sustaining) and suggest different tasks and governance mechanisms needed for effective learning in supply chains.

In recent years, several aspects of SCL have received widespread attention within the literature (Gosling et al., 2016; Powell and Coughlan, 2020), giving rise to a number of key SCL perspectives associated with operational learning (Yao et al, 2012), technological learning (Smart et al, 2007), management/organizational learning (Zhu et al., 2018) and sustainability learning (Roy et al, 2020). These learning opportunities emerge from the efforts of supply chain players to enhance information sharing (Huo et al., 2021), collaboration (Cheung et al., 2010) and coordination (Simatupang et al., 2002) to resolve supply chains’ emerging challenges.

Although the literature converges in recognizing the importance of SCL in its various dimensions, the literature still lacks a fine-grained understanding of the phenomenon and only a handful of studies have focused directly on the topic. For example, Bessant et al. (2012) suggest that formally configured groups of organizations such as supply chains and networks have become increasingly important channels for learning and innovation. Silvestre (2015) suggests that SCL is fundamental and happens through continuous supply chain learning loops where knowledge is acquired, which in turn leads to innovations that enhance supply chain sustainability trajectories. Gong et al. (2018) explore how multinational corporations orchestrate internal and external resources to help their multi-tier supply chains to learn sustainability-related knowledge. Yang et al. (2018) suggest that dynamic capabilities such as innovation, relationship, collaboration, integration mediate the relationship between SCL and supply chain

performance. More recently, Silvestre et al. (2020) argue that SCL supports the simultaneous employment of exploitation and exploration capabilities in supply chain initiatives that, in turn, generate a superior supply chain performance. Taking this scant body of literature into account, we argue that the concept is still immature and there is a need to further understand the SCL phenomenon in face of the modern challenges.

As per its nature, SCL is a complex phenomenon that must involve multiple supply chain partners often focusing on conflicting goals/interests, which may lead to important trade-offs (Blome et al., 2014). This means that both theory and practice should acknowledge that a priori the postulated link between SCL and supply chain performance is always positive may actually not be true. For example, learning the wrong or outdated knowledge could drive the supply chain to a direction it should not be going; or learning knowledge that is not relevant for the supply chain strategy or context could potentially overburden the supply chain and thus prevent the supply chain from identifying and acquiring the relevant knowledge it needs (Son et al., 2021; Villena et al., 2021). As a consequence, much more research attention should be derived to the SCL phenomenon.

Closing these gaps is important because SCL in practice still often occurs between focal companies and 1st tier suppliers, without cascading throughout the supply chain in areas where the focal companies have less control (Bessant et al. 2003; Gong et al., 2018; Jia et al., 2019). In this paper, we aim to extend the SCL literature towards a multi-tier approach and especially to cross-supply chain approach, departing from the perspective that a single supply chain does not operate in isolation, but interact, learn, share and build synergies with other supply chains. We propose a SCL typology based on the papers in this Special Issue and existing SCL literature in order to strengthen our understandings on this fundamental phenomenon and provoke future research on this important research topic.

This paper contributes to the literature in two ways. First, it proposes a novel typology of SCL based on two fundamental dimensions from the literature (i.e., *SCL driver* and *SCL network*), generating four types of SCL: *Captive*, *Consortium*, *Selective*, and *Distributed*. Second, echoing the concept of “learning organization” (Senge, 1994), we extend the supply chain theory by coining the concept of “The Learning Supply Chain”, which refers to a supply chain that learns constantly by employing all four types of SCL simultaneously in order to achieve the outcome the supply chain aims to achieve with that learning effort. If all or most supply chain players/entities are aligned and agree on the outcome to be achieved, then the SCL can be facilitated and expedited, allowing for better and faster supply chain results.

This paper is organized as follows: Section 2 provides a review of two fundamental SCL dimensions identified in the literature, i.e., *SCL driver* and *SCL network*; Section 3 proposes a typology of SCL; Section 4 further enhances the literature by providing a summary and a comprehensive review of the six papers that are part of this Special Issue along with the discussion of the construct of *The Learning Supply Chain*, additional contributions of this paper and future research directions.

2. Supply chain learning: a multi-faceted capability

There are various SCL dimensions that may impact the nature of the phenomenon. For example, the knowledge content could be related to operational learning (Yao et al, 2012), technological learning (Smart et al, 2007), management learning (Zhu et al., 2018) and/or sustainability learning (Roy et al, 2020). The type of the knowledge could be explicit or tacit (Schoenherr et al., 2014), the learning process could be classified as learning by doing/using, learning by searching, learning from spillovers or learning from interacting (Malerba, 1992), while the knowledge source could be external (i.e.,

acquisition from other players), internal (i.e., in-house knowledge development) or jointly developed knowledge (Cassiman and Veugelers, 2006).

While SCL can happen in many ways, and little empirical exploration has been done on the topic, we extracted from the literature two dimensions of fundamental importance: *SCL driver* and *SCL network*. *SCL driver* refers to the driving force behind the knowledge creation and diffusion in the supply chain (Spekman et al., 2002; Bessant et al., 2003). *SCL network* refers to the supply chain learning structure that is in place to create and diffuse new knowledge (Dyer and Nobeoka, 2000; Gong et al., 2018).

We selected SCL driver and SCL network dimensions to develop a typology because across a variety of literatures that study supply chain management (including supply chain sustainability, supply chain resilience and supply chain innovation), these two dimensions are commonly directly or indirectly recognized as significant factors affecting the dynamics behind SCL. For example, Spekman et al. (2002) suggest that partners' behaviour is a fundamental aspect in SCL while Bessant et al. (2003) argue that the triggers of SCL need to be identified first to successfully achieve SCL. Similarly, Dyer and Nobeoka (2000) highlight the importance of the supply chain network in the case they studied while Gong et al. (2018) explore the dynamics of SCL network to facilitate the sustainability SCL along multi-tier supply chains. Therefore, these two critical dimensions significantly affect not only the *modus operandi* of SCL (including drivers, roles, network structure and learning mechanisms) but also the outcomes of such SCL efforts in order to transform supply chain realities in the multiple contexts within which they operate.

In addition to their prominence in the literature, these two selected dimensions (i.e., *SCL driver* and *SCL network*) represent the ones that can provide the most insightful understanding on the SCL phenomenon in the sense that they shed new light on some

fundamental aspects related to the impetus for SCL (i.e., *SCL driver* - the driving force behind the SCL efforts - in its absence no learning can happen; focal companies vs. non-focal players, the role of power, legitimacy, coordination, etc) along with some of the critical elements associated with the complexity of supply chain interactions (i.e., *SCL network* - the supply chain learning structure creating and diffusing new knowledge; aligned vs. misaligned interests, dominant vs. peripheral within the supply chain, 1st tier vs. more distant areas of the supply chain, within-supply chain learning vs. cross-supply chain learning, etc).

2.1 – SCL Driver

SCL driver is the driving force behind the learning efforts put forward by supply chain players to create and diffuse knowledge and may facilitate or hamper SCL and the supply chain evolution in their learning trajectories (Silvestre, 2015; Sauer et al., 2022). The driving force could be centralized on a powerful focal company or on one or more non-focal supply chain players (Bessant et al., 2003; Gong et al., 2018).

We therefore categorize SCL driver as “focal company” or “non-focal player” depending on what is the driving the actions behind the SCL effort. Drawing on the literature, we characterize focal company driven SCL as those efforts that are initiated and led by focal companies, the most powerful supply chain player that motivates (or can exert pressure on) other supply chain players to achieve certain goals through learning (e.g., Roh et al., 2011; Moyano-Fuentes et al., 2021). For example, Vale (2004) studies focal company driven SCL in an automobile supply chain and found that the learning driven by these large and powerful corporations may result in an increased level of supplier dependency and their consequent inability to become integrated and learn from other sources due to the asymmetrical power in these types of relationships.

There are important implications associated with focal company driven SCL.

Most fundamentally, focal company driven SCL is often directed by the interests of one single company, i.e., the focal company pushes and promotes SCL in areas and in ways that will help that focal company to achieve its goals, which are not necessarily aligned with the supply chain goals more broadly (Zhu et al., 2018). On one hand, this aspect may facilitate **coordination** (Fugate et al., 2006; Gong et al., 2021) because the focal company is a powerful player within the supply chain, often resourceful and can pressure other players to participate and comply. However, for the same reason, these focal company driven SCL efforts may lack **legitimacy** among supply chain players and other external stakeholders (Lambrechts et al., 2012; Morais and Silvestre, 2018).

Additionally, we characterize non-focal player driven SCL as those efforts that are initiated and led by one or more non-focal supply chain player(s) that motivates (or exerts pressure on) other supply chain players to achieve certain goals through learning (Rahbek Pedersen, 2009). Such efforts can be driven for example by an industry group/association, innovation/technology, any competitive, social, environmental, governmental pressures and basically any challenges or opportunities the supply chain faces. For example, Gong et al. (2021) suggest that Better Cotton initiative, a global not-for-profit organization and the world's leading sustainability initiative for cotton, is the driving force behind SCL related to sustainable cotton practices. Silva et al. (2023) examine the important role of smaller geographically dispersed suppliers in developing country contexts, diffusing their own sustainability knowledge into larger global buyers.

Like focal company driven SCL, non-focal player driven SCL efforts present trade-offs. Most fundamentally, non-focal player driven SCL is attached to the interests of supply chain players that represent a more diverse set of stakeholders that pushes and promotes learning in areas and in ways that will help such stakeholders to achieve their goals (Ali et al., 2017). On one hand, although these goals may not necessarily be aligned

with the goals of the focal company and the supply chain more broadly, these non-focal player driven SCL efforts may gain **legitimacy** faster among supply chain stakeholders because they may be more easily perceived as a collective/common goal for the supply chain (Cegarra-navarro, 2005; Do et al., 2022). However, for the same reason, these non-focal player driven SCL efforts may hamper **coordination** (Simatupang et al., 2002; Fugate et al., 2006) because these efforts are more complex to coordinate (i.e., higher number of leading players involved), require additional shared resources and governance structures for participatory decision making processes (Azadegan and Dooley, 2021).

In sum, the nature of the driving force behind the SCL is fundamental and clearly involves tradeoffs. We reason that the driving force behind SCL, being a focal company or one or more non-focal player(s), is not necessarily good or bad *per se* as both SCL drivers are feasible and can produce successful outcomes.

2.2 – SCL Network

SCL network is the extent to which the knowledge created by and/or diffused by/to only internal supply chain players or by/to players operating across different supply chains, which may facilitate or hamper SCL and the supply chain evolution in their learning trajectories (Silvestre, 2015; Sauer et al., 2022). We therefore categorize SCL network as “closed” or “open” depending on the extent to which the learning and the knowledge is shared. Drawing from the literature, we characterize closed SCL networks as those efforts that are operationalized through supply chain structures formed by supply chain players from one single supply chain (Dyer and Nobeoka, 2000). For example, in an interesting study of a closed SCL network, Wilhelm (2011) explores the tensions and trade-offs between cooperation and competition in the overall network, using multiple case studies in the automobile supply chain.

There are important implications associated with closed SCL network. Most

fundamentally, closed SCL network is formed by supply chain players from one single supply chain (Jia et al., 2019). On one hand, this aspect may facilitate **alignment** because the interests of the participants are somewhat oriented to similar supply chain goals (Gattorna, 1998; Wong et al., 2012). However, for the same reason, these closed SCL networks may have a **myopic view** of the problems at hand due to the narrow boundaries that limit its knowledge, which can negatively impact supply chain performance in the long run (Svensson, 2007; Fawcett and Waller, 2012).

On the other hand, open SCL networks are those efforts that are operationalized through supply chain structures formed by players from multiple supply chains and this can be facilitated by for example cross-sector technologies (Van Hoek, 2019) or firms involved in operations of different supply chains (Yao et al., 2012). For example, Hall et al. (2012) argue that firms operating in different supply chains may be able to implement broader searches, learn and find satisfactory solutions to their overall challenges. Classic examples of open SCL networks are industrial clusters of small/medium sized companies that often operate across multiple supply chains, allowing their companies to constantly learn, share knowledge and innovate collectively (no matter which supply chain they participate in) without necessarily an active presence of a focal company (Humphrey and Schmitz, 2002).

Like closed SCL networks, there are important implications associated with open SCL networks. Most fundamentally, an open SCL network is formed by players from multiple supply chains (Luthra et al., 2022). On one hand, these open SCL networks may provide a **broader view** of the problems at hand to their participants because the perspectives of the players are more diverse (i.e., a multi-supply chain perspective), which can positively impact supply chain performance in the long run (Svensson, 2007; Fawcett and Waller, 2012). However, for the same reason, this aspect may hinder **alignment**

because the interests of the participants are diverse, sometimes conflicting and difficult to reconcile (Gattorna, 1998; Wong et al., 2012). For example, Wang et al. (2023, this issue) explore how supply chain regulations promoted by governments, under certain conditions, can generate robust SCL networks across different supply chains.

In sum, the nature of the network behind the SCL (i.e., either closed or open) is fundamental and clearly involves important trade-offs. We reason that the type of network behind SCL, being closed or open, is also not necessarily good or bad *per se* as both SCL networks are feasible and can produce successful outcomes.

3. A Typology of Supply Chain Learning

In Figure 1, we combine the two dimensions, *SCL driver* and *SCL network*, to produce a typology of four types of SCL, which we label *Captive*, *Consortium*, *Selective*, and *Distributed*. In this section, we summarize the pros and cons of each type and identify real examples that fit into each type.

SCL Driver	Non-Focal Player	CONSORTIUM SC LEARNING -One or more non-focal player(s) is/are the driving force behind the SCL. <i>Legitimacy</i> is likely to be higher, while <i>coordination</i> is more complex; -Knowledge is created by and diffused by/to only internal SC players. <i>Alignment</i> of interests is greater, but likely facing a <i>myopic view</i> ;	DISTRIBUTED SC LEARNING -One or more non-focal player(s) is/are the driving force behind the SCL. <i>Legitimacy</i> is likely to be higher, while <i>coordination</i> is more complex; -Knowledge is created by and diffused by/to players across different SCs. A <i>broader view</i> is likely to be in place, while <i>alignment</i> of interests is poor;
	Focal Company	CAPTIVE SC LEARNING -The focal company is the driving force behind the SCL. <i>Coordination</i> is facilitated, while <i>legitimacy</i> is likely to be lower; -Knowledge is created by and diffused by/to only internal SC players. <i>Alignment</i> of interests is greater, but likely facing a <i>myopic view</i> ;	SELECTIVE SC LEARNING -The focal company is the driving force behind the SCL. <i>Coordination</i> is facilitated, while <i>legitimacy</i> is likely to be lower; -Knowledge is created by and diffused by/to players across different SCs. A <i>broader view</i> is likely to be in place, while <i>alignment</i> of interests is poor;
		Closed	Open
		SCL Network	

Figure 1: Typology of Supply Chain Learning

Captive SCL is associated with the learning efforts that are driven by the focal company through a network that is closed to other supply chains as the knowledge is created and diffused within the supply chain only. We call it “captive” because it represents the interests of the most powerful player in the supply chain, i.e., pressure is high for other supply chain players to participate and sometimes they do not have even the choice to opt-out due to asymmetric power relations (Huo et al., 2017). In addition to that, the knowledge is generated by and diffused by/to players within the same supply chain. In some sense, the knowledge resulted from these SCL efforts also become captive inside that particular supply chain and cannot be (or simply is not) shared with other

supply chains (Gereffi et al, 2005). While these SCL efforts can have their coordination facilitated (because a single powerful and often resourceful company is leading the effort) and present a greater alignment (because all participants operate in the same supply chain), these SCL efforts may lack legitimacy (because they represent the interest of one single company, the focal company) and be embedded in myopic views (due to the fact that their perspective is limited to the context of that particular supply chain).

Consortium SCL is associated with the learning efforts that are driven by non-focal players through a network that involves supply chain players from one single supply chain. We call it “consortium” because these SCL efforts signify the interests of broader groups of players or entities that represent larger group of stakeholders in the supply chain, e.g., suppliers, government, NGO, activist groups (Macdonald, 2007). These types of SCL efforts may be perceived as “collective” in terms of the interests they represent. In addition, knowledge is generated by and diffused by/to players within the same supply chain and cannot be (or simply is not) shared with other supply chains. While these SCL efforts have greater alignment among participants (because all of them operate in the same supply chain) and may gain legitimacy quickly (because they are perceived as collective efforts), these SCL efforts are more complex to coordinate due to a more diverse set of players leading the effort, and may be embedded in myopic views (due to the fact that their perspective is limited to the knowledge of that particular supply chain).

Selective SCL is associated with the learning efforts that are driven by focal companies through a network that involves supply chain players from multiple supply chains. We call it “selective” because these SCL efforts represent the interests of a focal company that selectively identify partners within its supply chain and in other(s) supply chain(s) to create and diffuse the knowledge (Yao et al., 2012). Therefore, the knowledge is generated by and diffused by/to players across different supply chains gaining

important synergies and multiplying the impact of the knowledge generated (Niu and Shen, 2022). While these SCL efforts can have their coordination facilitated (because a single powerful and often resourceful company is leading the effort) and have broader views (due to the fact that there are perspectives from different supply chain contexts), these SCL efforts may lack legitimacy (because they may be perceived as representing the interest of one single company) and have poor alignment among players (because participants operate in different supply chains).

Distributed SCL is associated with the learning efforts that are driven by non-focal players through a network that involves supply chain players from multiple supply chains. We call it “distributed” because these SCL efforts have the ability to involve the most diverse set of players and the knowledge generated can permeate the furthest into multiple supply chains (Sawhney and Prandelli, 2000). While these SCL efforts may gain legitimacy quickly (because they are perceived as collective efforts) and have broader views (due to the fact that there are perspectives from different supply chain contexts), these SCL efforts are more complex to coordinate (because a more diverse set of players is leading the effort) and have poor alignment among participants (because participants operate in different supply chains).

None of these four SCL types is good, bad, better or worse *per se* in terms of achieving the expected outcomes of the SCL efforts. The critical element for the success of these efforts is the level of fit between the type of SCL (i.e., *Captive*, *Consortium*, *Selective*, and *Distributed*), the type of knowledge to be created and diffused, and the outcome supply chains aim to achieve with that SCL effort.

4. From supply chain learning to “The Learning Supply Chain”

4.1. An overview of the papers in the Special Issue

This Special Issue aims to advance research on the topic of SCL. Although a central topic in most of the supply chain literature, the way SCL is operationalized is still under researched and requires further attention. In this Special Issue, we invited papers that contribute to the SCL discourse in many different ways. Table 1 summarizes the six papers in this Special Issue with their classification in our typology. Mimicking the existing literature, the majority of the papers adopt a Captive SCL approach (four papers), while only one adopts a Distributed SCL approach, one adopts a Selective SCL approach, and none takes the Consortium SCL approach.

From the SCL driver perspective, aligned with existing research on SCL, the majority of the selected papers have a central focus on focal company driven SCL. For example, Chen et al. (2023 – this issue) conduct a meta-analysis and assume focal firms can learn from suppliers and customers, which follows the traditional focus of survey studies on SCL. Dong et al. (2023 – this issue) explore focal company's supply chain network and complexity on the level of SCL. Jiang et al. (2023 – this issue) treat SCL as a moderator and explore focal firms' relational-specific investments and sustainability performance. Silva et al. (2023 – this issue) focus on the sustainability learning of sub-tier suppliers driven by the focal firms' needs. Yu et al. (2023 – this issue) explores the focal companies' knowledge network and supply chain network. Finally, there is only one paper focuses on drivers from non-focal supply chain players, Wang et al. (2023 – this issue) – study SCL driven by Chinese government's supply chain policies which have allowed supply chains to learn, share, disseminate the knowledge across different supply chain networks. From the SCL network perspective, only two papers adopt an open SCL network approach (Yu et al., 2023 – this issue; Wang et al., 2023 – this issue) while the others adopt a closed SCL network approach.

From the theory perspective, all the Special Issue papers have consistently applied and made important contributions to theories. Interestingly, the six papers all have applied different theories. Chen et al. (2023 – this issue) adopt knowledge-based view in which knowledge is the main content of SCL. Dong et al. (2023 – this issue) apply contingency theory and explore the antecedents of SCL. Jiang et al. (2023 – this issue) apply two theories: relational view and resource orchestration theory. Silva et al. (2023 – this issue) adopt the practice-based view, which emphasizes the importance of organizational learning practices in shaping supply chain's capabilities and competitive advantages. Yu et al. (2023 – this issue) suggest that SCL can be also explored together with other networks (such as knowledge network) that a network pluralism is applicable. Finally, Wang et al. (2023 – this issue) apply information processing theory to explore the SCL efforts driven by government supply chain policies.

From the geographic perspective, of the six papers, four have an explicit focus on China (i.e., Dong et al., 2023 – this issue; Jiang et al., 2023 – this issue; Yu et al., 2023 – this issue; and Wang et al., 2023 – this issue), one in Brazil (i.e., Silva et al., 2023 – this issue) and one non-empirical paper (Chen et al., 2023 – this issue). We didn't purposely select the papers with any specific geographic focus, but as one of the world's largest manufacturers, China offers a fertile space for SCL. Similarly, Brazil is an important space for SCL associated with resource-based supply chains such as agriculture/argi-food and energy/oil and gas (e.g., Silva et al., 2023 – this issue).

From the research methodology perspective, this SI contains a diverse range of research methods. Silva et al. (2023 – this issue) apply a case study method with two ethnographies completed during 74 days of observations. Chen et al. (2023 – this issue) adopt a meta-analysis approach which is an objective, quantitative and systematic means of collating all previous studies on a specific topic. Dong et al. (2023 – this issue) apply

a fuzzy set qualitative comparative analysis (fsQCA), which is capable of analyzing complex causal links among different factors and could determine the best linkage between condition and outcome variables from various combinations of causal conditions. Both Yu et al. (2023 – this issue) and Wang et al. (2023 – this issue) adopt a panel (secondary) data analysis approach. Yu et al. (2023 – this issue) use patent application data and supply chain partner information from 869 listed firms between 2011 and 2020, while Wang et al. (2023 – this issue) use secondary data derived from the ‘Supply Chain Policy’ launched by the Chinese government in 2017 and two related large conferences (May 2018 and November 2019). Panel data have been used to support the analysis at a macro level which extends previous SCL focus at one network level (closed network) (Yu et al., 2023 – this issue) and explore national supply chain policies (Wang et al., 2023 – this issue). Jiang et al. (2023 – this issue) is unique in this Special Issue as it applies a mixed-method approach including both case study and survey. The case study helps the authors to strengthen their understanding on the constructs of relational-specific investments and sustainability performance which supported the survey design.

From the positioning of SCL perspective, both Chen et al. (2023 – this issue) and Wang et al. (2023 – this issue) explore SCL’s outcomes. Chen et al. (2023 – this issue) focus on the relationship between SCL and organizational/supply chain performance, while Wang et al. (2023 – this issue) explore SCL and operational resilience. Both Dong et al. (2023 – this issue) and Yu et al. (2023 – this issue) explore SCL’s antecedents of supply chain network and complexity, and knowledge network embeddedness. Jiang et al. (2023 – this issue) treat SCL as a moderator between relational-specific investments and sustainability performance. Silva et al. (2023 – this issue) focus on supply chain sustainability learning by sub-tier suppliers.

From the SCL content perspective, Chen et al. (2023 – this issue) propose four types of knowledge contents: general knowledge, business knowledge, process knowledge and technical knowledge. They found that business-related knowledge had the strongest effect on performance. Wang et al. (2023 – this issue) explore SCL of supply chain policies, supply chain best practices. Silva et al. (2023 – this issue) focus on SCL of sustainability, while Yu et al. (2023 – this issue) assume supply chain collaboration as SCL practices. Both Dong et al. (2023 – this issue) and Jiang et al. (2023 – this issue) treat SCL as creation and dispersion capacities: the former reflects the interaction outcomes of team and learning orientations, while the latter reflects the interaction effects of system and memory orientations.

4.2. The Learning Supply Chain

This paper offers two theoretical contributions to the literature. First, we propose a typology of SCL, based on the extant literature with four types of SCL: *Captive*, *Consortium*, *Selective*, and *Distributed*. Table 2 shows some key exemplar papers from the SCL literature exploring specific types of SCL as proposed in our typology. None of these four SCL types is however good or bad *per se* in terms of achieving the expected outcomes of the SCL efforts. Similarly, none of these four types is better or worse than the others. The critical element for the success of these efforts is the level of fit between the type of SCL (i.e., *Captive*, *Consortium*, *Selective*, and *Distributed*), the type of knowledge to be created and diffused, and the outcome supply chains aim to achieve with that learning effort. We reason that each one of these types of SCL will work better under certain conditions. We call for further research on successful and unsuccessful adoption of these four different SCL types as well as the types of knowledge they create/diffuse and the outcomes that these SCL efforts can generate.

Second, we propose the construct of “The Learning Supply Chain”, which refers

to a supply chain that learns constantly by employing all four types of SCL simultaneously (i.e., *Captive*, *Consortium*, *Selective*, and *Distributed*), and deploying them depending on the type of knowledge to be created and diffused, and the outcome supply chains aim to achieve with that learning effort. Players participating in Learning Supply Chains are embedded in strong awareness regarding the significance of continuous learning, collaboration and the employment of different learning modes, not only between focal companies and the 1st tier of suppliers/buyers, but also across the entire supply chain (including players positioned distantly in the supply chain) and sometimes across supply chains. This, in turn, sheds new light on how supply chain players can create mechanisms and processes to achieve and foster agile and effective SCL toward the establishment of a “*Learning Supply Chain*”. Additional research is needed to help understand how the construct of “Learning Supply Chain” is operationalized in practice and what are the conditions that most significantly impact their outcomes.

Based on the contributions this Special Issue offers, multiple opportunities for future research can be identified. We call for additional SCL research from a variety of regions and countries. Existing research focus mostly on a few countries. With the global trend on reshoring, nearshoring, and regional sourcing to be more resilient in post COVID-19 period, we would anticipate that SCL will be more prominent in diversified and emerging regions such as India, Vietnam, and Mexico. We believe SCL is a fundamental phenomenon that will allow for the development of supply chain learning capabilities, and therefore future research can focus on understanding SCL from the perspective of different geographic regions. Similarly, we also call for more research on SCL in global supply chain contexts (i.e., less localized). Although existing research has been advancing knowledge by focusing on certain countries/regions, there are limited

insights on SCL in the global supply chains. Silva et al. (2023) provides a good example of such research as it explores six dyadic relationships with one supplier based in Brazil and six buyers in Japan, UK, US, Israel, Canada and Spain respectively. In the same way, Biotto et al. (2012) explores the global coffee supply chain with the focal firm based in Italy along with multi-tier suppliers across the globe. Future research can explore SCL with multi-tier global supply chains spread across different regions, with different cultural background, market conditions, and legal frameworks.

We call for further research using multi-method approaches and innovative research methodologies. As SCL is an emerging topic, we believe case study and other exploratory approaches are still relevant and remain a powerful method to develop SCL related concepts and theories. Panel data could be useful especially to explore SCL from an open network perspective (Selective SCL and Distributed SCL), yet existing research tend to focus on focal companies' major suppliers and buyers forming the supply chain network (Captive SCL). Future research could propose innovative methods to contrast with existing research and especially mixed-methods to overcome the disadvantages of single methods. Given the fact that SCL takes time to operationalize in practice through the learning stages (Bessant et al., 2003; Cormack et al., 2021), future research can explore longitudinal approaches that are still rare in the literature.

SCL with a sustainability focus remains fundamental as a future research priority. As sustainability has become an important strategy for supply chains (Gong et al., 2018, 2021; Silvestre et al., 2020; Silva et al., 2023), future research can advance the status of this topic as an opportunity to understand critical aspects of it such as long term perspectives, complex issues associated with multiple supply chain stakeholders' interests and required stakeholder engagement (Roy et al. 2020). Future research can focus on topics such as SCL on carbon neutrality (Zhang et al., 2022a, b), circular economy (De

Angelis et al., 2018), supply chain sustainability trajectories (Silvestre, 2015) and how supply chains balance the triple bottom line decisions (economic, environment, and social) in SCL (Sauer et al., 2023).

From the SCL driver perspective, we call for more research from non-focal player SCL (Consortium SCL and Distributed SCL). Existing research tend to explore SCL empirically from a focal firm perspective (Bessant et al., 2003; Gong et al., 2018), with limited research from other perspectives such as supplier (Silva et al., 2023), sub-tier suppliers (Silva et al., 2023 – this issue), other insightful approaches such as knowledge network approach (Yu et al., 2023 – this issue) and government policy driven SCL (Wang et al., 2023 – this issue). Our Special Issue offers research from these scarce, non-focal firm perspectives, which could inspire future researchers. In the same way, future research could also explore SCL launched by other organizations such as government organizations, non-government/not-for-profit organizations, industry associations, consulting firms, auditing firms, standardization organizations (Silvestre and Silva Neto, 2014). In addition, besides the focus on firms' strong social ties, future research can also explore SCL with weak social ties, which may be essential for radical and disruptive innovations (Todo et al., 2016). Furthermore, given their specificities, future research can also explore the role of small and medium-sized enterprises (SMEs) in SCL.

From the SCL content perspective, future research can focus more on innovative technologies, which is scarce in the literature, especially those technologies that could cover multi-tier or even cross-supply chain perspectives such as artificial intelligence (Baryannis et al., 2019), blockchain (Van Hoek, 2019), and the Internet of Things (Ben-Daya et al., 2019). During the exploration and implementation of such technologies, SCL takes place more intensely to facilitate its smooth implementation, overcome the challenges, and achieve maximum outcomes. Similarly, rather than focusing on best

practices, future research can explore failures, crisis and disruption management. COVID-19 provides such an example that emphasises the important of resilience and adaptability in supply chain management (van Hoek, 2020; Sarkis, 2020). We believe that failures, crisis and disruptions can facilitate agile SCL and knowledge sharing, providing valuable insights on how supply chains can face future disruptions.

We hope that this paper and the papers in this Special Issue more broadly will become inspirational for researchers, practitioners, and policy-makers who are interested and involved in theory and practice of SCL. We believe important and challenging theoretical advancements are still required for SCL to become central to the practice of supply chain management and unleash all the transformative potential it has.

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Paper	Region	Theory	Method	SC driver	SC network	SCL Typology	Main contributions
Chen et al. (2023 – this issue)	NA	Knowledge-based view	Meta-analysis	Focal company (absorption learning, joint learning)	Closed network - Learning from suppliers, customers	Captive SCL	It provides a comprehensive understanding on the relationship between SCL-performance relationship via meta-analysis.
Dong et al. (2023 – this issue)	China	Contingency	Survey (Fuzzy set qualitative comparative analysis)	Focal company	Closed network - Supply chain network	Captive SCL	It explores the relationship between supply chain network, complexity and SCL behaviours. It provides new explanation to the antecedents of SCL that what configurations of structures can lead to high or low level of SCL ability.
Jiang et al. (2023 – this issue)	China	Relational view and resource orchestration	Multi-method (case study and survey)	Focal company	Closed network - Learning with supply chain partners in general	Captive SCL	SCL mediates the link between relational-specific investments and sustainability performance.
Silva et al. (2023 – this issue)	Brazil	Practice-based perspective	Case study	Focal company	Closed network - Multi-tier with a focus on sub-tier suppliers	Captive SCL	Based in a multi-tier food supply chain, this research explores the way sub-suppliers build knowledge and learn sustainability practices in terms of waste management, biosecurity and animal welfare.
Wang et al. (2023 – this issue)	China	Information processing	Panel data	Non-focal player - Government	Open network - Knowledge on supply chain	Distributed SCL	It explores how SCL affects operational resilience. Digital-technological diversity could weaken the role of SCL in

				(supply chain policy)	policies, loose social network		operational resilience, while customer concentration, and participating in pilot programme could enhance the effect.
Yu et al. (2023 – this issue)	China	Network pluralism	Panel data	Focal company	Open network - Knowledge network and supply chain network	Selective SCL	This research examines the relationship between firms' knowledge network embeddedness and their SCL practices in a supply chain network. It also explores the moderating role of supply chain network cohesion in the relationship.

Table 1: SCL Typology - Classification of papers in this Special Issue (papers in alphabetical order)

Paper	Region	Theory	Method	SC driver	SC network	SCL Typology	Main contributions
Silvestre (2015)	MNE operating in Brazil	Institutional	Case study	Focal company – Petrobras	Closed network - Focal firm and multi-tier supply chain	Captive SCL	Highlights the importance of the context and environmental turbulence to observe and coin the terms SCL loops and SCL trajectories
Gong et al. (2018)	MNEs operating in China	Resource orchestration	Case study	Focal companies - Nestle, IKEA, Tetra Pak	Closed network - Focal firm and multi-tier supply chain	Captive SCL	Explore the SCL networks launched by focal firms and how do they implement multi-tier sustainable supply chain initiatives.
Giannoccaro (2015)	NA	Complex adaptive systems	Agent-based simulation / NK modelling framework	Industrial districts of SMEs	Open network – learning and adaptation in supply chains located within industrial districts of SMEs	Consortium SCL	It explores the design of adaptive supply chains focusing on learning as one of the critical capabilities leading to adaptation by investigating the relationship between learning and adaptation in supply chains located within industrial districts.
Silva et al. (2023)	Brazil	Knowledge-based view	Case study	Local coffee suppliers	Closed network - Global buyers learning from local suppliers (supplier-buyer dyads)	Consortium SCL	It demonstrates how supplier developed and transferred its own sustainability knowledge with supplier-buyer dyads. Buyer selection is an important strategy to promote supply chain sustainability learning.

Hall et al. (2012)	Brazil	Complexity	Case studies	Focal company	Open network – focal companies selectively learning from other supply chains	Selective SCL	It argues that focal firms may find satisfactory solutions to their broader sustainability strategies by investing in other supply chains.
Van Hoek (2019)	North America and Europe	Technology adoption	Multi-method (focus group, survey, case study)	Focal companies (technology pioneers)	Open network – Blockchain adopters learning from RFID pioneer adopters	Selective SCL	It leverages knowledge on the implementation of RFID in supply chains to accelerate the learning process for blockchain implementation in supply chains.
Yao et al. (2012)	USA	Organizational and supply chain learning	Datasets from companies with 14,290 observations are used in the analysis	Manufacturer / suppliers / buyers / third party service providers	Open network – supply chain dyad’s self-learning, learning spillovers from EDI, and from other supply chain dyads	Distributed SCL	It argues that self-learning, learning spillovers from EDI, and learning spillovers from other supply chain dyads, all have positive and significant impacts on a distributor’s inventory performance.
Luthra et al. (2022)	India	Stakeholder and resource-based view	Multi-method (AHC, Fuzzy Delphi and F-DEMATEL)	Mixed industry experts	Open network – cross-sector collaboration and learning in circular supply chain management	Distributed SCL	It explores the barriers to collaborative efforts across sectors to facilitate Circular Supply Chain Management practices

Table 2: SCL Typology - Classification of key selected papers from the literature