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# The role of start-ups as knowledge brokers: a supply chain ecosystem perspective

## Abstract

**Purpose** – Existing literature is limited in its ability to consider start-ups as a knowledge broker to trigger innovation in a supply chain ecosystem (SCE). In a traditional SCE, start-ups are relatively isolated, leading to structural holes that limit knowledge sharing among members. This paper aims to overcome that limitation and to build frameworks that help to illustrate the interaction between knowledge management and sharing, start-up innovation, and an ecosystem from a supply chain perspective.

**Design/methodology/approach** – Following a qualitative approach, we theorize about the role of start-ups as knowledge brokers and the implications of knowledge management and sharing with members in an SCE concerning innovation. Conceptual analysis is used for examination, and we employ a set of qualitative tactics to interpret and generate meaning from the existing literature.

**Findings** – We develop two frameworks to provide insight into how start-ups can trigger innovation as knowledge brokers in an SCE. The first framework shows how start-ups, and their knowledge base, influence supply chain members and the overall ecosystem, highlighting the isolated function of start-ups and the issue of structural holes in a traditional SCE. We propose a model that illustrates how structural holes can be bridged within an SCE, thereby demonstrating how start-ups redefine the ecosystem architecture according to their knowledge broker position in the SCE.

**Originality/value** – By expanding insight into the concepts of how start-ups can trigger innovation as knowledge brokers in an SCE, this paper extends the so-far neglected area of start-ups and knowledge brokers. We clarify the conceptual and theoretical components and processes in an SCE and link the different roles of start-ups as knowledge brokers to the respective supply chain members to better understand the implications on the entire SCE.

**Keywords:** Supply chain ecosystem; start-ups; knowledge brokerage; innovation

**Paper type:** Research paper

## 1. Introduction

Knowledge is a crucial resource that enables firms and systems to gain a competitive advantage (Rajabion *et al.*, 2019), as knowledge generation and sharing leads to innovation and value creation (Del Giudice and Della Peruta, 2016; Del Giudice and Maggioni, 2014). There is a general agreement among scholars that producing innovation requires collaboration and knowledge sharing among different actors, both within and outside the firm. These collaborations allow firms to access additional resources and knowledge that can trigger innovations (Arlbjørn and Paulraj, 2013; Chesbrough, 2003; Ozman, 2009; Samuel *et al.*, 2011; Sivakumar and Roy, 2004).

Por (1997), however, found that "knowledge exists in ecosystems, in which information, ideas, and inspiration cross-fertilize and feed one another," indicating that knowledge management is

part of a more complex innovation ecosystem perspective (Adner, 2017; Adner and Kapoor, 2016; Canestrino *et al.*, 2020; Scaringella and Radziwon, 2018). The emphasis in an innovative ecosystem lies in understanding how interdependent actors interact to build and market innovations that benefit an end customer (Jacobides *et al.*, 2018). More recently, scholars have pointed out the increasing complexity and interdependence among many heterogeneous firms for value creation. They also suggest a shift from *innovation ecosystems* to *supply chain ecosystems* (SCEs) to better model and understand the supply chain network and its innovation dynamics (Hearnshaw and Wilson, 2013; Wagner, 2021). In that sense, knowledge management in an SCE provides “*opportunities for mutual learning and at the same time enables all members to work together in a way that creates truly new value*” (Wang and Hu, 2020, p. 94).

Existing research also found that knowledge sharing among supply chain members may pose a risk if not handled properly, potentially costly and ineffective (Alghail *et al.*, 2021; Li and Lin, 2006). To effectively implement knowledge sharing, current literature points to individual or so-called organizational *knowledge brokers* that can mediate interactions between unconnected actors by disseminating knowledge and creating linkages between other relevant members in the ecosystem (Crupi *et al.*, 2020; Goggin and Cunningham, 2021; Nambisan *et al.*, 2019; Ritala *et al.*, 2017; Waardenburg *et al.*, 2022). In so doing, knowledge brokers guarantee the flow of knowledge between parties that are not directly related (Abbate *et al.*, 2013; Garcia-Perez *et al.*, 2020; Verona *et al.*, 2006). In particular, knowledge brokers enable unconnected actors on a *structural hole* to exchange information and pursue common goals, thereby findings pathways to bridge these structural holes and play a critical role in the conversion of knowledge (Burt, 2007; Gebert *et al.*, 2003).

Formal knowledge management structures, particularly regarding knowledge sharing and knowledge brokerage, are usually more present in large companies than in small companies or start-ups (Crupi *et al.*, 2020). Start-ups lack formal knowledge management structures due to their limited access to tangible and intangible assets and thus face difficulties in implementing these practices effectively (Dayan *et al.*, 2017a; Mårtensson, 2000). However, although start-ups have access to fewer human and financial resources, there is a general agreement in the literature that recognizes that start-ups are a ‘source of innovation’ and are seen as drivers of technological change (Galvão *et al.*, 2019; Lukeš *et al.*, 2019). In fact, start-ups have established clear pathways to exploit and share knowledge and resources in their ecosystem to trigger innovation processes (Van der Borgh *et al.*, 2012).

So far, little attention has been given to the role of start-ups as knowledge brokers, particularly from an SCE perspective. In this paper, we attempt to close that gap by providing insights into the different functions of start-ups as knowledge brokers in an SCE. In particular, we propose that start-ups may have a leading position as knowledge brokers within an SCE because of their inner attitude to introduce innovation and generate growth and scalable business models (Wagner, 2021). This need for innovation fosters start-ups to integrate the knowledge arising in different knowledge domains, identifying processes and using ideas from all the actors in the ecosystem (Hargadon and Sutton, 1997; Spigel and Harrison, 2018). As such, there is a need to examine the role of start-ups in an SCE and provide a more nuanced perspective on how they can trigger innovation as knowledge brokers. We expressly set the following research question: *How can start-ups as knowledge brokers trigger innovation in an SCE?*

In this paper, we theorize about the neglected role of start-ups as knowledge brokers and the implications of knowledge management and sharing with members in an SCE regarding innovation. The aim of this paper is twofold. Firstly, this study will illustrate the relationships between start-ups, knowledge brokerage, and the supply chain network needed to trigger innovation, but also highlight the structural holes in a traditional SCE. To do so, we combine literature from these research streams and consolidate their critical concepts into a framework that presents the linkages between start-ups and the different members of the supply chain network concerning knowledge management and knowledge brokerage. We argue that current literature is limited in explaining the role of start-ups as knowledge brokers, and an SCE provides a theoretical foundation to categorize better the role of start-ups from a knowledge management perspective.

Second, we use the main concepts in the framework to build a model that depicts and categorizes the role of start-ups as knowledge brokers and their implications not only on the different members in the supply chain but also on how structural holes in the SCE can be bridged. Although scholars acknowledge the role of start-ups as drivers for innovation, a structural approach to depict the linkages between start-ups and their implications on an SCE from a knowledge brokerage view is missing. In particular, we will explore how start-ups as knowledge brokers can trigger innovation and bridge the structural holes for a) suppliers, b) service providers, and c) customers in an SCE. Proposing this conceptual model is the main theoretical contribution of this paper. From a practical point of view, our model provides suggestions on how start-ups could bridge the structural holes in SCEs, thus triggering the innovation capacity of the whole system.

The remainder of the paper is as follows: in the next section, we provide an overview of the role of start-ups and knowledge management in a traditional SCE, thereby highlighting the limitations of existing literature and emphasizing the issue of structural holes. It is followed by the methodology section, where we present our interpretative approach to help analyze how start-ups can act as knowledge brokers in an SCE. Section 4 then presents our conceptual model and analyses start-ups as knowledge brokers for the supply chain members, suppliers, service providers, and customers. We conclude the article with our theoretical and managerial contributions, highlight the limitations of this study and provide avenues for future research.

## **2. Literature Review**

Globalization and the rapidity of technological changes intensify the competitive environment, impelling firms to improve the knowledge base they have to innovate continuously (Shahzad *et al.*, 2020). Knowledge has become one of the most strategically-significant resources, and there is an increasing recognition that the ability to create, transfer, use and protect knowledge assets is a crucial issue in maintaining or increasing competitiveness (Ireland and Hitt, 1999; Riege, 2005). Since very few firms can develop a wide range of knowledge internally, firms' accessibility to external knowledge is crucial to improve their innovative performance (Abdulkader *et al.*, 2020; Jantunen, 2005; Scuotto *et al.*, 2017).

It is particularly true for start-ups due to their inner attitude to use knowledge and knowledge sharing to innovate, generate growth and create scalable business models (Wagner, 2021). Start-ups' fast decision process makes them more flexible in responding to external changes through continuous innovation (Mikl *et al.*, 2021). Although start-ups have access to fewer human and

financial resources and try to build their legitimacy in the market, there is a broad agreement in the literature recognizing that start-ups are a 'source of innovation' and can be seen as drivers of technological change (Galvão *et al.*, 2019; Lukeš *et al.*, 2019). Start-ups are more agile as they communicate more informally and directly, disseminating knowledge quickly and making fast decisions within the organization (Siegel *et al.*, 2003). As part of the scalable model and the associated need for growth, quick decisions making is necessary to develop and introduce new services and products to generate cash flows and serve customers and investors. This need for innovation fosters start-ups to integrate the knowledge arising in different knowledge domains, identifying processes and using ideas from all the actors in the ecosystem (Hargadon and Sutton, 1997). Both relationships and knowledge sharing are supported and facilitated by the direct and informal communications the start-ups are used to (Allen *et al.*, 2016).

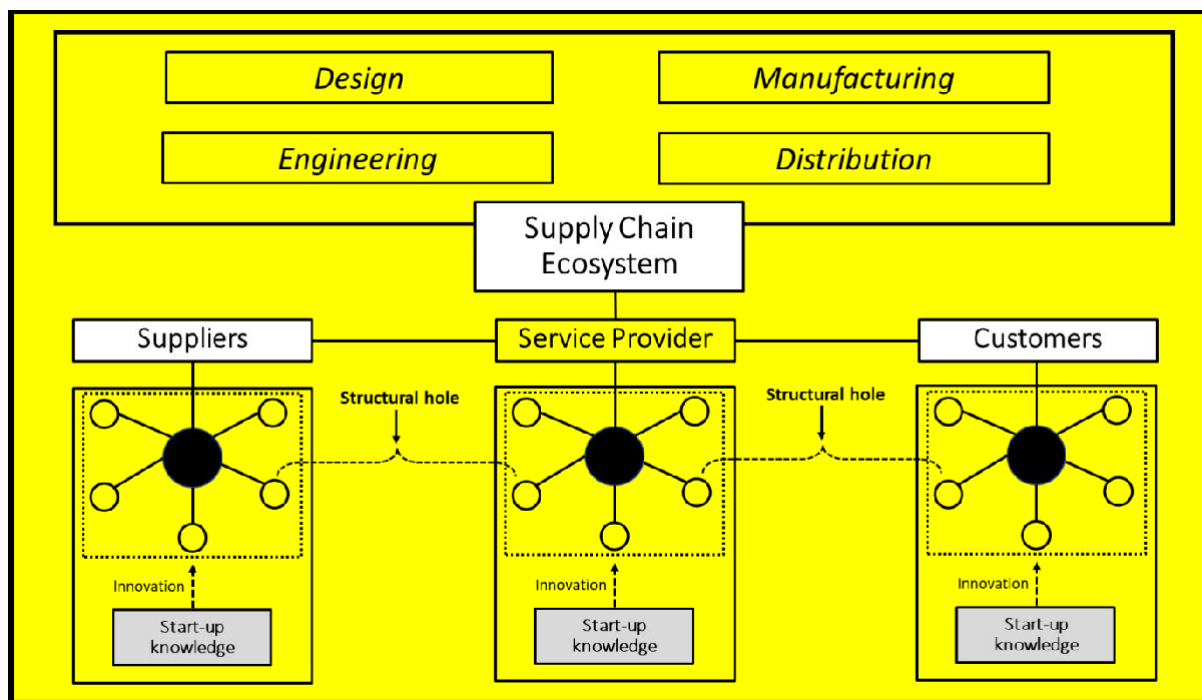
More recently, however, the academic debate about innovation and economic growth has gradually shifted from the traditional knowledge transfer process to the more complex ecosystem perspectives (Canestrino *et al.*, 2020; Scaringella and Radziwon, 2018). Introducing and implementing innovative ideas is a complex process and innovating alone is very difficult (Del Giudice and Della Peruta, 2016). Collaboration becomes essential as it allows firms to share risks and enables participating members in an ecosystem to reduce innovation time through sharing resources (Dayan *et al.*, 2017b).

To better examine the relationships in complex ecosystems, scholars moved more recently from the concept of an *innovation ecosystem* to a *supply chain ecosystem* (SCE) (Liu *et al.*, 2019; Xing *et al.*, 2021). The innovation ecosystem concept arises from the general notion of a system employed in natural science (Adner, 2017; Adner and Kapoor, 2016) and draws upon the former concept of the *business ecosystem*, initially proposed by Moore (1993). To clarify the difference between both concepts, de Vasconcelos Gomes *et al.* (2018) claim that a "*business ecosystem relates mainly to value capture, while an innovation ecosystem relates mainly to value creation*" (p.30). Hence, pursuing a different aim, value capture vs. value creation, distinguishes business and innovation ecosystems, with the last ones devoted to generating new value through innovation. Scholars acknowledge that innovation is not a linear process involving various activities. In contrast, it is the result of the participation of different players (cooperating companies - including suppliers and customers, private and public R&D facilities, and (business) external R&D facilities) that create, share and diffuse new ideas into the market (De Marchi and Grandinetti, 2013; Meissner and Kotsemir, 2016; Meissner and Zaichenko, 2012).

The increasing complexity of ecosystems with different players and interests has led to the development of an SCE, in which start-ups also play a crucial role (Mikl *et al.*, 2020; Mollenkopf *et al.*, 2020; Wagner, 2021). In contrast to business or innovation ecosystems, Muckstadt *et al.* (2001) define an SCE as the processes that involve designing, engineering, manufacturing, and distributing products or services from suppliers to end-consumers. In other words, an SCE comprises a complex system consisting of an upstream network of multi-tier suppliers, service providers, and downstream customers. In this system, managing creating, storing, transferring, sharing, adopting, and applying the knowledge is crucial to driving innovation. Scholars also see supply chains as "a cradle of knowledge" (Samuel *et al.*, 2011, p. 285), as knowledge transfer comprises multiple members along the supply chain with varying backgrounds, exposure, and cultures. Between those elements, know-how, skills, and capabilities are created on a network level; thus, value is created for the network and the supply chain participants. As such, knowledge-based supply chains are increasingly seen as

opportunities to use resources better and make better value for clients (Bereznoy *et al.*, 2021; Wadhwa *et al.*, 2008).

Traditionally, start-ups are isolated in an SCE as they directly link to one of the upstream or downstream supply chain members (see Fig. 1). Depending on the above, scholars point out the lack of knowledge sharing between supply chain members. The lack of knowledge sharing leads to *structural holes* in the ecosystem (Ganguly *et al.*, 2019; Mäkelä, 2007). However, each actor may play a different role in the ecosystem depending on its coordination ability and capacity to trigger innovations. Of interest for this study is the identification of the so-called ‘keystone player’ (Iansiti and Levien, 2004). A keystone player “acts to improve the overall health of the ecosystem ... It does this by creating and sharing value with its network by leveraging its central hub position” (Gawer and Cusumano, 2014, p. 72). The keystone player sets the ecosystem goals, facilitates the connections between and among the different actors, and feeds the systems by sharing its knowledge, delivering information, and coordinating local ties (Yao *et al.*, 2020). In this sense, the *keystone player* becomes a *knowledge broker*, disseminating knowledge, linking/networking, adapting/translating knowledge, acquiring knowledge, and enhancing partners' innovation capacity.



**Figure 1: Start-ups in a traditional SCE**

According to Burt (2007), knowledge brokerage (or brokering) means enabling unconnected actors on a structural hole to exchange information and pursue common goals. Along with conceptualizing the structural holes, Jorge *et al.* (2016) introduced the notion of 'information brokers', involved in creating and communicating information to specific groups of people for a particular purpose or specific aim. Previous studies uncovered how different actors could bridge structural holes in different contexts, thus acting as brokers. For example, Melkas and Harmaakorpi (2008) examined brokerage functions in regional innovation networks, suggesting that regional science and technology parks, technology transfer organizations, universities, and

research centers may actively support effectively breaking in the structural holes, supporting innovation. Stadtler and Probst (2012) investigated how broker organizations may facilitate public-private partnerships for development, acting as conveners, mediators, and learning catalysts. According to Ciulli *et al.* (2020), digital platform organizations have taken a bridge role in the food supply chain, particularly connecting circularity holes. More recently, Wijewickrama *et al.* (2021) found that the government is responsible for bridging structural holes in the circular supply chain by performing roles such as regulating, subsidizing, and leading.

Despite increasing interest, the literature lacks systematic frameworks and models combining knowledge management and the ecosystem perspective (Bolisani and Bratianu, 2017), particularly from a start-up perspective. Iansiti and Levien (2004) suggested that the *keystone* is often a well-established and large firm, thus neglecting the role of start-ups as a knowledge broker of the innovation ecosystem. In contrast, we support the idea that start-ups can have a leading position to develop and introduce new innovative services and products for growth. In particular, we propose that start-ups can be regarded as knowledge brokers by establishing connections between investors, customers, suppliers, and other stakeholders in the marketplace, thus benefitting from how knowledge is transferred and translated between organizations. Start-ups as knowledge brokers can act as facilitators to transfer knowledge between clients and other external knowledge sources with which the customers do not interact or are not related. As a consequence, start-ups can collaborate with their clients to create innovative solutions from their knowledge base.

So far, it remains unclear how start-ups can act as knowledge brokers in an SCE and trigger innovation. In particular, the role of start-ups as knowledge brokers to bridge structural holes in an SCE has not been examined yet. As a response, we attempt to provide insight into these dynamics and answers that can help close that gap. In the next section, we provide the research approach that can help us to clarify the roles of start-ups as knowledge brokers in an SCE.

### **3. Research approach**

This paper aims to illustrate the role of start-ups as knowledge brokers and present an associated conceptual model, particularly how start-ups can bridge structural holes and establish a link between all members of the SCE. Scholars agree that knowledge brokers act not only as transfer facilitators of knowledge but also recognize their role in the conversion of knowledge, comprising the localization, identification, dissemination, distribution, scaling, and transformation of knowledge (Gebert *et al.*, 2003). To depict and categorize start-ups as knowledge brokers and their implications in the SCE, we will theorize, rather than describe, the role of start-ups as knowledge brokers and the implications of knowledge management and sharing with members in an SCE concerning innovation. When employing a qualitative approach, it is essential to distinguish between ‘theory’ and ‘descriptions’ for this exploratory study (Corbin and Strauss, 1990).

The theory is based on evidence-based concepts where similar and relevant data sets are grouped and labeled, i.e., the data is interpreted, and the different concepts are related through statements of relationships. For example, the link between the concepts of supply chain ecosystems and knowledge management and sharing has already been established (Schniederjans *et al.*, 2020; Zhang *et al.*, 2019), so is the relationship between knowledge

management and structural holes (Di Vincenzo *et al.*, 2012; Liu and Zhu, 2020). By contrast, in descriptions, data may be structured along themes that can also conceptualize data. However, there is neither any interpretation of the identified data nor an attempt to relate the identified themes to a conceptual presentation. More broadly, we follow the argument of Mishler (1990), who argues that “qualitative studies ultimately aim to describe and explain a pattern of relationships, which can be done only with a set of conceptually specified categories” (p. 421).

As such, we use conceptual analysis to examine and showcase the role of start-ups as knowledge brokers in an SCE. More specifically, we employ a set of qualitative 'tactics' (Miles and Huberman, 1994) to generate meaning from the existing literature. By examining the concepts behind knowledge management, start-up innovation, and SCEs, we can make inductions, derive meaning from the interplay between the concepts, and make deductions to interpret the relationships and implications (Patton, 2014). The research approach in this study comprises the following four steps:

*Step 1:* Combining literature examining the relationships between start-ups, knowledge brokerage, and the supply chain network needed to trigger innovation and consolidate their critical concepts. So far, current literature is limited to explaining the role of start-ups as knowledge brokers and consolidation of concepts. It provides a theoretical foundation to categorize the relationships among them better.

*Step 2:* Analysis of the relationships among the different concepts to look for patterns and similarities in the literature to classify linkages and identify categories of meaning. This step correlates with Boyatzis (1998) argument for recognizing patterns in seemingly random information. For example, it was not only found that knowledge brokers are invention factories, gatekeepers, or knowledge transformers (Crupi *et al.*, 2020). The analysis also showed the emergence of the theme of structural holes (Haring, 2014; Zaheer and Bell, 2005) in an SCE, thus presenting a research gap concerning start-ups as knowledge brokers. Consequently, this step did demonstrate not only the significance of the structural holes in an ecosystem but also the first framework depicting the somewhat isolated role of start-ups in a traditional SCE.

*Step 3:* Synthesize the research streams to clarify relationships among themes and meaning, resulting in new conceptual derivations that can help answer the research aim. For example, as a result of the synthesis, we decided to use a simplified SCE represented by a network of organizations consisting of suppliers, service providers, and customers. More specifically, we examine the role of start-ups as knowledge brokers for a) suppliers, b) service providers, and c) customers and how to bridge structural holes. This step involved an iterative and repetitive process, including confirming or verifying the new conceptual derivations.

*Step 4:* A conceptualizing and building of a model that depicts and categorizes the role of start-ups as knowledge brokers and their implications not only on the different members in the supply chain but also on how structural holes in the SCE can be bridged. The depiction of the different roles of start-ups provides a conceptual foundation for the examination and analysis of how start-ups as knowledge brokers drive innovation for the respective member of the supply chain and the SCE as a whole.

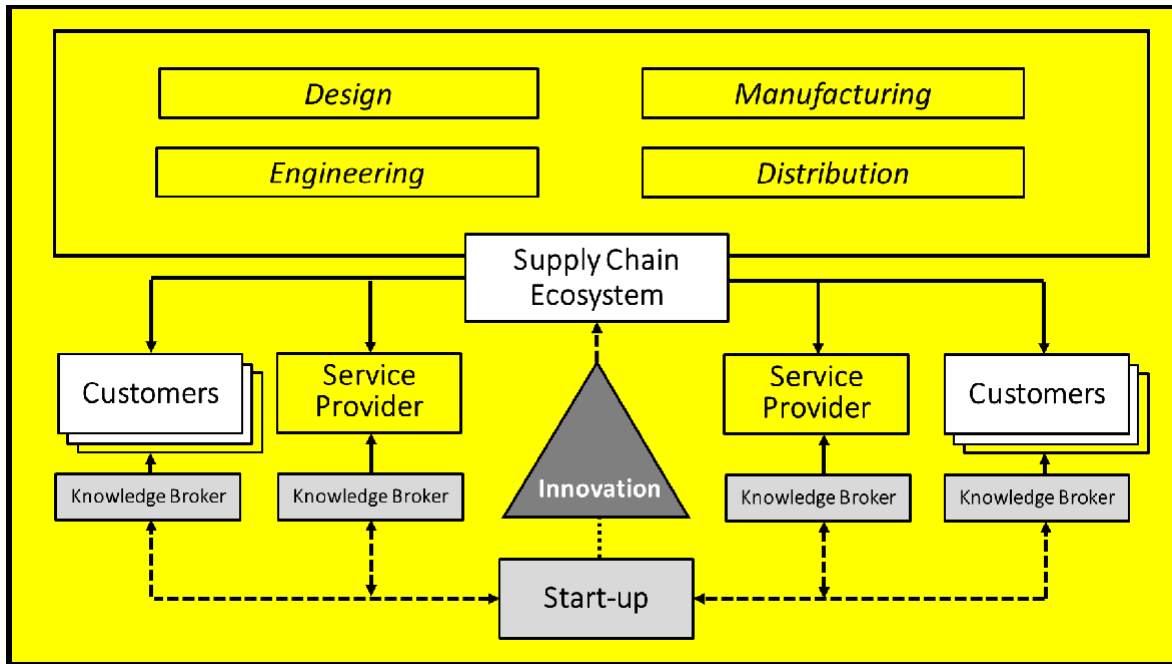
#### **4. Towards a new framework for start-ups as knowledge brokers in SCEs**

Scholars used to depict supply chains as relatively simple linear systems characterized by different actors interacting through dyadic relationships and isolated clusters (Cox *et al.*, 2006; Herold *et al.*, 2021b). These models lack the complexity of existing supply chains and fail to describe the interdependence among the multiplicity of members in the ecosystem. Pathak *et al.* (2007) particularly highlighted the need to reconceptualize supply chains from simple linear systems to complex adaptive systems. To do so, supply chain researchers applied the theoretical and empirical developments in complex network literature to the context of supply chains as complex adaptive systems. For example, Hearnshaw and Wilson (2013) advanced supply chain network theory to underline the role of multi-tier interactions of upstream suppliers, downstream customers, and service providers in the value co-creation process. Lusch (2011) proposed to apply the concept of the 'service ecosystem' in the exploration of supply chains to “*better capture the nesting of supply chains with larger and more encompassing value networks*” (p. 15).

Moreover, customers embedded in a given ecosystem are no longer merely passive recipients of services (Lusch *et al.*, 2016) but are considered resource integrators for acquiring strategic advantages (Vargo and Lusch, 2008). In the same vein, Ketchen *et al.* (2014) argue that supply chains transform into ‘supply ecosystems’ where interactions enable different actors, competitors, or collaborators to adapt to external changes. Canestrino *et al.* (2018) found that interaction among supply chain players also represents a fundamental source of innovation and value co-creation at both the individual and network levels.

Knowledge brokers play a critical role in the evolution of innovation ecosystems by accessing external knowledge and diffusing it. Within ecosystems, knowledge brokers may intermediate between disconnected actors guaranteeing access to diverse, non-redundant knowledge (Antonioli *et al.*, 2017; Yao *et al.*, 2020; Yu *et al.*, 2022), positively affecting the innovativeness of the whole system. It is particularly true for structural holes in an SCE and how knowledge brokers can bridge or overcome these structural holes in the system. We still know very little about the role played by the knowledge brokers within the SCEs. Therefore, we contribute to the literature by adapting this concept to the SCEs, focusing on the role played by the start-ups. As a result, we propose a new model to provide a theoretical foundation to categorize the role of start-ups as knowledge brokers in an SCE.

Fig. 2 depicts the simplified SCE model as a network of organizations consisting of suppliers, service providers, and customers. In this SCE, start-ups act as knowledge brokers for a) suppliers, b) service providers, and c) customers. The depiction of the different roles of start-ups provides a conceptual foundation for examining and analyzing how start-ups as knowledge brokers drive innovation for the respective member of the supply chain and the SCE as a whole.



**Figure 2: Start-ups as knowledge brokers in an SCE**

In general, start-ups collect or generate information, interpret it according to the context, and communicate or exchange it between detached actors. In other words, they may connect the actors in a supply chain, facilitating information and knowledge exchange among them. In so doing, start-ups trigger the innovation capacity of the SCEs, providing collaboration between and among the different actors through the different stages of the innovation process. The role of brokerage of start-ups extends from linking suppliers, customers, and service providers to setting up a space for knowledge sharing and co-creation, co-development of innovation, and shaping the architecture of the innovation system. It is in line with other studies reporting the ability of innovation intermediaries (brokers) to change the architecture of the national innovation system (Klerkx and Leeuwis, 2009). The role of start-ups as ecosystem brokers enables them to bridge structural holes and become innovation system architects in different positions they may occupy in an SCE. In the following sections, we will elaborate on each linkage between start-ups and the supply chain members, that is, the start-ups' relationship as a knowledge broker to suppliers, service providers, and customers.

#### **4.1 Start-up as knowledge brokers for service providers**

Start-ups can act as knowledge brokers for service providers, which often act as intermediaries by offering a range of services that established firms traditionally provide (Bharadwaj *et al.*, 2013; Dobrovnik *et al.*, 2018; Mikl *et al.*, 2020; Sandström *et al.*, 2009; Sucky and Asdecker, 2019). For example, these start-ups promise to provide better and more cost-efficient, real-time, and on-demand transport arrangements due to better use of digital know-how or extensive data analysis techniques (Mikl *et al.*, 2021). During the last decade, investments in supply chain start-ups have constantly been growing, with a growth of around 3.5 billion US\$ in 2017 alone (Wyman, 2017). In contrast to incumbent companies, which use digital tools to maintain "their existing business architectures [...], start-up companies radically change their operating models, relying heavily on data analytics and the platform economy" (Hahn, 2020, p. 1425).

However, Cichosz *et al.* (2020) found that start-ups need to leverage internal and external knowledge to collaborate successfully with customers and suppliers.

From a knowledge broker perspective, start-ups for service providers can influence the entire ecosystem, i.e., both suppliers and customers. For example, start-ups increasingly use artificial intelligence to share knowledge along the supply chain to increase efficiency (Akhavan and Namvar, 2021; Lee *et al.*, 1997b). Often, suppliers and customers have different or asymmetric information about the demand (Desiraju and Moorthy, 1997; Simatupang *et al.*, 2002). The customer side can better predict sales than the supplier, while the supplier has a better overview of lead times and production capacity. Traditionally, this relationship between customers and suppliers led to rather periodic large batch orders, leading to demand variances (Lee *et al.*, 1997a; Wu and Katok, 2006). Start-ups working for service providers and specializing in demand forecasting, however, can not only work with the customer side to better understand and predict sales demand but also act as knowledge brokers by sharing the demand information with the supplier (Chen *et al.*, 2000; Liu *et al.*, 2022).

As such, start-ups for service providers can drive innovation and efficiency along the supply chain by acting as knowledge brokers for both the customers and the suppliers. In particular, digital start-ups use decision support systems and software applications to facilitate knowledge sharing with suppliers and customers (Intezari and Gressel, 2017; Wang and Hu, 2020). However, effective use of service providers' knowledge requires the coordination and integration of all supply chain members. For example, the processes of collecting, processing, and disseminating information among supply chain members have to be accompanied by a readiness to share knowledge of the associated logistics tasks that drive financial and operational performance (Shih *et al.*, 2012; Singh and Power, 2014; Umar *et al.*, 2021).

#### ***4.2 Start-up as knowledge brokers for suppliers***

Start-ups can also act as knowledge brokers for suppliers, as buying companies try to increase their competitiveness by engaging and utilizing the innovations stemming from start-ups. Zaremba *et al.* (2016) found that the engagement of buying companies to work with start-ups is based on: a) the supplier's ability to produce innovation, b) the supplier's product offer that drastically enhances the buying companies' product and sales, and the c) supplier's ability to offer advanced technologies and advanced products. Practice shows that start-ups as suppliers are well established in the corporate world, with established companies such as BMW collaborating with start-ups (Gimmy *et al.*, 2017).

When start-ups act as knowledge brokers for suppliers in an SCE, it is essential to distinguish between exploration and exploitation strategies concerning knowledge brokerage. Exploration represents developing novel organizational practices and solutions (i.e., efficacy driven), while exploitation is built on existing knowledge to further leverage and refine existing practices (i.e., efficiency-driven). As suppliers, the start-ups' exploration strategy, which is often based on creating innovations based on digitalization tools, requires a high level of knowledge and high-qualified employees. However, the inter-organizational knowledge sharing with customers aims to trigger the exploitation strategy, resulting in an optimization of practices and the need for low-qualified employees (Wilkesmann and Wilkesmann, 2018), highlighting the challenges of knowledge brokerage along the supply chain.

From a knowledge broker perspective, start-ups may rely on *supply chain entrepreneurial embeddedness* (SCEE). SCEE may be defined as the degree to which the SCE can integrate the "supply chain small entrepreneurial business capabilities such as those fostering creativity, ingenuity, resourcefulness, rapid-decision making, and swift execution" (Ketchen and Craighead, 2021, p. 51). Moreover, Zaremba *et al.* (2017) suggest using the concept of *new venture partnering capability* (NVCP), which can be defined as a company's capacity to "gear its supplier management – evaluation, development, communication, and governance – toward new ventures while accounting for their characteristic features" (p.51). In order to achieve success in this relationship, the supplier must adapt their processes and integrate the knowledge with the start-up itself.

Consequently, integrating knowledge provided by start-ups as knowledge brokers emphasizes the need to share information as a critical success factor. Start-ups as knowledge brokers for suppliers thus contribute with their knowledge base to collaborative supply chain practices such as Vendor Managed Inventory, Enhanced Web Reporting, Efficient Consumer Response, Collaborative Planning, Forecasting, and Replenishment (CFPR). This not only implies a strategic approach to knowledge brokerage and sharing (for forecasting or production planning) but also the development of knowledge that is essential for the stabilization of the network (Samuel *et al.*, 2011).

#### ***4.3 Start-up as knowledge brokers for customers***

Start-ups can also act as knowledge brokers for customers, as members of the SCE acknowledge the value-added knowledge of the start-ups' innovative ideas and the associated unique know-how and capabilities for the system's services and products. Often, these start-ups, as knowledge brokers for customers, focus on digitalization within the supply chain, utilizing artificial intelligence or robotics to automate routine tasks and labor-intensive processes in customer service, accounting, invoicing, or purchasing (Ciampi *et al.*, 2020; Lyall *et al.*, 2018). Integration of all these services will enable companies to single-handle and manage the supply chain as long as the knowledge from the data can be extracted and used along the supply chain (Herold *et al.*, 2021a; Schniederjans *et al.*, 2020).

From a knowledge broker perspective, start-ups, as knowledge brokers for customers, are able to drive innovation by providing information to the service providers and establishing links to suppliers. For customers, start-ups can establish themselves as 'lead users,' which can be defined as "a special group of customers that experience needs unknown to the public, which they address by creatively using their technical expertise" (Al-Zu'bi and Tsinopoulos, 2012, p. 671). As 'lead users,' start-ups may attract renowned firms as additional suppliers, thereby increasing the knowledge base in the SCE. That is what La Rocca *et al.* (2019) calls 'resource mobilization' and point to the concept of increasing customer attractiveness when established firms work "with the stars of tomorrow" to demonstrate the company's pioneering mindset (Wagner, 2021). Start-ups for customers may also act as knowledge brokers by providing the necessary tools to analyze and manage large amounts of data for service providers in the SCE. Here, the start-ups' knowledge sharing is restricted to new technologies and associated information systems and the quality of information within the supply chain using data analytics and data management both for tacit and explicit knowledge.

Thus, start-ups as knowledge brokers for customers contribute to the service providers' knowledge base and the inter-organizational knowledge management in the entire SCE. In other words, start-ups as knowledge brokers can play a crucial role in collaborating and coordinating with members along the supply chain and sub-consequently creating and establishing knowledge-based tools which can increase the companies' capabilities (Samuel *et al.*, 2011; Spekman and Davis, 2004). However, given that start-ups can be considered to be emerging, the knowledge brokerage along the supply chain can be linked to the concept of the "Learning Supply Chain" (Bessant, 2004; Yang *et al.*, 2018), which Spekman *et al.* (2002, p. 42) define "as a vehicle for gathering knowledge and learning."

## 5. Conclusion and Implications

If start-ups can act as knowledge brokers in an SCE, then the framework that describes these interactions expand insight into the concepts and implications and thus advance organizational research. So far, the existing literature is limited in its ability to consider start-ups as knowledge brokers in an ecosystem and along the supply chain. This paper intends to overcome that limitation and to build frameworks that help to describe the interaction between knowledge management and sharing, start-up innovation, and an ecosystem from a supply chain perspective. We developed two frameworks to provide insight into the nature of these interactions. The first framework showed how start-ups, and their knowledge base, influence supply chain members and the overall ecosystem. It also illustrated the somewhat isolated function of start-ups and highlighted the issue of structural holes in a traditional SCE. We thereby have clarified the conceptual and theoretical components and processes in an SCE from a start-up and knowledge perspective. In order to address and categorize the different roles of start-ups as knowledge brokers, we proposed a model that illustrates how structural holes can be bridged within an SCE. We also pointed out how start-ups may redefine the ecosystem architecture according to their knowledge broker position in the SCE.

By expanding insight into the concepts of start-ups as knowledge brokers in an SCE, this paper makes several significant contributions to the literature. Firstly, we present a simplified model, which depicts the key components of start-ups in an SCE and its associated processes. This model links the different roles of start-ups as knowledge brokers to the respective supply chain members to better understand the implications on the entire SCE. Secondly, by categorizing the roles of start-ups as a) suppliers, b) service providers, and c) customers. The model explicitly addresses how knowledge is brokered within all elements and drives innovation and structural holes. This study thereby clarifies the roles of start-ups as knowledge brokers and the direct and indirect links between the elements. Third, the depiction and description of start-ups as knowledge brokers advances the growing body on implications of knowledge management, which to date has been limited in explaining knowledge transfer in an SCE. Lastly, by categorizing the roles of start-ups as knowledge brokers, our models point to practices through which management can exert and manage knowledge in an SCE.

These findings must be viewed in light of the model's limitations. In particular, it needs to be mentioned that this simplified model does not consider the broader entrepreneurial ecosystem consisting of additional actors that are indirectly involved in the supply chain performance. We encourage future researchers to extend our framework by including or expanding on other elements in an ecosystem. Supply chains are subject to complex processes and interactions, and the focus on suppliers, service providers, and customers restricts it to three members in the

supply chain. Future research may also test the framework and use case studies to determine the influence of start-ups as knowledge brokers on the SCE. Overall, research on how start-ups can act as knowledge brokers in an SCE is in its infancy. Hence future research will help us to understand better how knowledge affects SCEs.

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