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KNOWLEDGE DIFFUSION IN A GLOBAL SUPPLY NETWORK: A NETWORK OF PRACTICE VIEW

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ABSTRACT

This study investigates how knowledge diffusion occurs in a globally dispersed supply network, wherein buying firms and suppliers often do not have strong relationships and competitive tensions prevail. We elaborate the Network of Practice (NoP) view by examining a global supply network in the food sector that is as an exemplar of high global dispersion. This paper provides several novel insights into global knowledge diffusion. We introduce the NoP concept of *homophily* into the field of supply chain management to explain knowledge diffusion within global supply networks. We take a longitudinal perspective to show that although prior contractual ties (*relational homophily*) and co-location (*location homophily*) initially drive knowledge diffusion, in the long-term, shared practices (*practice homophily*) are the principal driver of knowledge diffusion. First, Second, we demonstrate that buying firms' assurance of *procedural justice*, together with the predominance of geographically dispersed suppliers and the emergence of *nexus members*, can help dampen supplier resistance to knowledge diffusion. The study shows that knowledge diffusion in a global supply NoP occurs in two complementary forms of knowledge diffusion - broadcasting forums and action groups - which vary in breadth, depth, and tie diversity. Ultimately, we present vertical (buyer-supplier), horizontal (supplier-supplier), and diagonal (non-competitive) relationships as important refinements of the NoP view that characterize a global supply NoP. Overall, our findings offer a pathfor buying firms to establish adequate online infrastructureto support the emergence of decentralized and self-organized knowledge diffusion in a globally dispersed supply network.

Keywords: Global supply network, Knowledge diffusion, Network of practice, Homophily

INTRODUCTION

Knowledge is a strategic resource, and the ability to diffuse knowledge within supply networks is a strategic supply network capability (Dyer & Nobeoka, 2000). To capitalize on this strategy, firms have typically established long-term, trust-based collaborative relationships and co-location, which have been seen as the most effective means of diffusing knowledge among suppliers (Bourlakis et al., 2014). However, the globalization of supply networks in the last few decades has made this strategy of knowledge diffusion more challenging. Many buying firms now have sparse global supply networks, which includes the buying firm, direct suppliers, sub-suppliers and non-supply-chain stakeholders (Miemczyk et al., 2012). In globally dispersed supply networks, weak ties between members and high geographic dispersion prevails (Hall & Matos, 2010). These weak, arm's length relationships are not thought to support knowledge diffusion within a supply network context. To our knowledge, there has yet to be a study using the NoP lens within an inter-organizational, multi-tiered supply network context.

Recent scholarship within supply chain management (SCM) has indicated that weakly-tied members in a supply network may be able to transcend the limitations of their arm's length relationships and work together collaboratively on a short-term basis (Kim & Choi, 2015). This possibility increases the plausibility of knowledge diffusion in a globally dispersed supply network.However, it is not well understood how such an environment facilitates or inhibits knowledge diffusion. In addition, research that emphasises direct suppliers (e.g. Gelderman & Van Weele, 2002; Kraljic, 1983) may blind buying firms to the important role of critical low-tier suppliers, many of which are invisible to buying firms(Yan et al., 2015).

This study builds on recent scholarship and asks the research question (RQ): *how does knowledge diffusion occur across weak ties in a globally dispersed supply network?* To answer the above question, we elaborate the diffusion branch of social network theory;

specifically, we investigate the Network of Practice (NoP) view, which was originally developed in an intra-organizational context (Brown & Duguid, 2001). The NoP view posits that geographically dispersed individuals who share the same practices can exchange knowledge, despite a lack of relational ties and high geographic dispersion (Brown & Duguid, 2001). However, what is missing from this intra-organizational NoP view is the threats of competition among network members, which is a salient factor in a supply network. Despite the possibility that suppliers with similar practices might be motivated to share knowledge in order to improve their shared practices, the threat of supplier-supplier competition might also demotivate them to freely share practice-specific knowledge. Therefore, whether sharing similar practices motivates knowledge diffusion remains a puzzle in a supply network context.

To resolve this puzzle, we investigate the food sector as supply networks within this sector are typically global and geographically dispersed. The food sector is basically composed of farming and distribution. While the distribution phase has become consolidated into a few large international players (Beske et al., 2014), the farming phase has maintained its dispersed nature and high horizontal competition due to a large number of globally dispersed suppliers (Sporleder & Moss, 2002). Such high competition and high global dispersion leads to price-based relationships, high supplier turnover rates, and low levels of trust (Mena et al., 2013). Such structural characteristics in global food supply networks are said to hinder knowledge diffusion (Sporleder & Moss, 2002), and therefore constitute a resourceful sector to our study of weak ties and knowledge diffusion.

We develop a model of a *global supply NoP*, which captures the processes through which knowledge is diffused across a globally dispersed, multi-tiered supply network that combines a wide variety of types of ties between a buying firm, its direct and indirect suppliers, and non-supply-chain members, including vertical buyer-supplier relationships, horizontal

supplier-supplier relationships, and diagonal non-competitive relationships. Central to our model is the concept of *practice homophily*, which is the process through which knowledge is diffused among members of a network that engage in similar practices, such as producing the same product for a focal firm. By introducing this concept to a supply network context, we show that knowledge diffusion is possible within global supply networks, despite the presence of competitive tensions in supplier-supplier ties and despite fears of disintermediation in buyer-supplier ties. Our model also uses contextual moderators: buying firms' *procedural justice* within the coordination of the supply network, the predominance of globally dispersed suppliers, and the participation of prominent non-supply chain members, such as academic and consulting experts that help diminish these barriers.

This research contributes to both theory and practice. For theorists, we explain how time influences knowledge diffusion, showing that although initially positive, the effects of both prior contractual ties (*relational homophily*) and co-location (*location homophily*) diminish in the long-term and can be substituted by *practice homophily*. These results contradict prevalent SCM research and advance the incipient research on gracious buyer-supplier relationships, which are based on weak but collaborative ties (Kim & Choi, 2015). Therefore, this study highlights weak ties and its previously unexplored benefit to knowledge diffusion in a supply network (Carnovale & Yeniyurt, 2015; Nair et al., 2016). For practitioners, we suggest that buying firms leading knowledge diffusion initiatives should not restrict their strategy to building long-term bonds with specific suppliers; rather, they should also consider setting up a *global supply NoP*.

THEORETICAL BACKGROUND

Knowledge Diffusion in a Supply Network

When studying knowledge diffusion in supply networks, extant SCM research has emphasized the benefits of local and dense supplier clusters for diffusing knowledge, often benchmarking the renowned Toyota supply network (Wilhelm, 2011). However, such an approach is often cost prohibitive in a globally dispersed and unstable supply network (Handley & Benton Jr, 2013). Consequently, many buying firms cannot afford to build strong, collaborative ties even with all first-tier suppliers, let alone with lower tier suppliers. As such, geographic dispersion in contemporary supply networks has been noted as a significant barrier to knowledge diffusion beyond direct suppliers. Additionally, geographic dispersion creates challenges for knowledge diffusion due to suppliers' differences in culture (Grekova et al., 2014), economic background (Hall & Matos, 2010) and institutions (Parmigiani & Rivera-Santos, 2015). As a result, most buying firms managing globally dispersed supply networks have resorted to an arm's length supply management approach based on standards enforcement and monitoring mechanisms (e.g. Lim & Phillips, 2008). But top-down enforcement is often detrimental for knowledge diffusion due to a lack of trust, autonomy, and motivation to participate (Brockhaus et al., 2013; Touboulic et al., 2014).

Recent research shows that a collaborative approach is preferred to an enforcement/compliance approach, since mutual agreements across the supply network reduce costs for both the buying firm and suppliers (Meinlschmidt et al., 2018). An alternative to the cascading enforcement/compliance approach lies in acknowledging that buying firms are not the sole protagonists of supply networks. For instance, Yan et al. (2015) offer a typology for identifying key low-tier suppliers, or *nexus suppliers*, which likely exist undetected by buying firms. In reality, knowledge diffusion may actually occur through a combination of control (enforcement/compliance) and emergence (dynamics not led by the

buying firm) (Choi et al., 2001). The factors facilitating and preventing knowledge diffusion in a globally dispersed supply network have not been so far the focus of SCM research; hence, we explore these factors in this study.

Social Network Theory in SCM Research

To better understand the dynamic of knowledge diffusion in a supply network, we use the diffusion branch of Social Network Theory (SNT) as our theoretical lens. SNT examines economic phenomena through a network lens based on two foundational elements: nodes and ties. Nodes are the members that compose the network and interact in many possible ways, and the relationships between the nodes are called ties (Borgatti & Foster, 2003). Network members can be connected by multiple types of ties, such as friendship, formal contracts, or knowledge exchange, which in SNT are referred to as network layers (Borgatti et al., 2013). In a supply network context, network layers represent different types of interactions between members of the supply network, such as contracts, product flows, and knowledge sharing (Kim et al., 2011).

SNT is a rich body of literature in which diverse theoretical frameworks co-exist, but SCM research has so far only partially explored SNT diversity. The seminal review of the SNT literature by Borgatti & Foster (2003) maps all the variants of SNT and classifies them according to their focus/independent variable: performance versus diffusion focus. The performance focus reflects an evaluative approach, meaning that theories in this branch focus on the benefits of an individual's connections and position in the network structure; this approach evaluates an individual's performance as well as an individual's agency. In other words, the performance focus explains why some firms are different than others. Conversely, the diffusion focus looks at how network connections and structure shape an individual node through the diffusion of attitudes, knowledge, and practices. In other words, diffusion

explains how homogeneity between firms shapes firms' actions, such as adopting a new attitude or acquiring new knowledge (Borgatti & Foster, 2003).

In Table 1, we show how SCM scholarship has employed SNT in order to highlight the skewed emphasis on performance within SNT literature (left side of Table 1).

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SCM studies focused on performance are based on an assumption that social capital - specifically, relational capital and structural capital - is the goal of supply networks. Relational capital studies have suggested that "trust is the pivot of the factors influencing inter-organizational knowledge sharing" (Cheng et al., 2008, p. 283) and that a lack of trust is a major impediment to knowledge sharing (Hoejmose et al., 2012; Theißen et al., 2014). Structural capital studies have linked performance to preferable positions within network structures. Central nodes would have access to a large number of nodes, and in turn, better access to resources than marginal nodes, and members of a dense supplier network would access knowledge more easily than members of sparse supplier networks (see: Carnovale & Yeniyurt, 2014; Kim et al., 2015; Kim et al., 2011). However, this scholarship fails to explain knowledge diffusion that occurs when there is an absence of trust and when supply networks are not comprised of local and dense supplier clusters. As a matter of fact, such scholarship often postulates that geographic dispersion is an impediment to knowledge diffusion (Hartmann & Moeller, 2014; Silvestre, 2015).

Our study calls for a fresh perspective on knowledge diffusion in globally dispersed supply networks and studies ideas currently unexplored in SCM research (shifting to the right side of Table 1). There is a lack of understanding regarding the conditions under which globally dispersed knowledge diffusion can occur. We shift our attention from local, densely-

clustered supply networks to global supply networks. In addition, we do not look at individual nodes, but we study network dynamics instead. In doing so, we explore the diffusion branch of SNT scholarship.

The Diffusion Perspective

The diffusion perspective posits *homophily* as a driver of knowledge diffusion with homophily defined as "the tendency for people to interact more with their own kind – whether by preference or induced by opportunity constraints" (Borgatti & Foster, 2003, p. 999). Within this perspective, knowledge diffusion occurs due to *homophily* between members in the network (Rivera et al., 2010). One focus within diffusion studies is Communities of Practice (CoP) scholarship, which posits that small groups where everyone knows each other and works closely together share a great deal of knowledge, therefore explaining knowledge diffusion as due to *relational homophily* (Wenger, 1998). CoPs are dense supplier communities that exhibit high degrees of reciprocity thus inducing knowledge exchange between individuals from the same community as well as preventing knowledge sharing between different communities (Brown & Duguid, 1991). SCM research does not use CoP terminology, but has long recognized the benefits of dense supplier communities for knowledge diffusion. For example, SCM research in China has shown *guanxi* dynamics that represent ties between firms where employees share familiar ties and personal links that influence relationships and knowledge sharing (Chen et al., 2004). Similarly, SCM research in Japan has described the iconic cases of Toyota and Honda to demonstrate how cultural traits foster knowledge diffusion in long-term buyer-supplier relationships (Wilhelm, 2011). In brief, SCM supports *relational homophily* as a key driver of knowledge diffusion despite using different terminology. Additionally, *location homophily* (here referred to as simply co-location) has also been considered a driver of knowledge diffusion by management scholars

both generally (Dyer & Nobeoka, 2000) and within the SCM literature (Bansal & McKnight, 2009; Wilhelm, 2011) since knowledge is easily and inexpensively shared through face-to-face meetings (Ambrose et al., 2008). Ultimately, prior contractual ties and co-location – respectively *relational* and *location homophily* - are posited as drivers of relational advantages and knowledge diffusion (Yli-Renko et al., 2001).

Conversely, *practice homophily* has only recently been suggested as an alternative conduit for knowledge diffusion within the NoP perspective. The NoP literature has explored knowledge diffusion in geographically dispersed and sparse networks where there is a lack of trust and relational ties between network members (Brown & Duguid, 2001). Brown & Duguid's (2001) seminal study of Xerox's efforts to disperse information across its global business units is a good example of how *practice homophily* drives knowledge diffusion despite large geographical distances. Following studies confirmed that shared practices can drive interactions and act as a substitute for relational intensity (Wasko & Faraj, 2005; Wasko et al., 2009). The choice of the term 'network' in the NoP aims to reflect that relationships within a network are weaker than those among the members of a community (Tagliaventi & Mattarelli, 2016). Specifically, an 'NoP' is defined as a loose group in which most members will never know, know of or meet one another. However, in such NoPs, *practice homophily* can trigger a great deal of knowledge diffusion (Brown & Duguid, 2001).

This study builds on previous NoP scholarship that suggests *practice homophily* can occur despite geographic dispersion when network members can identify "a single goal, direction, criterion, process, or solution which helps to counterbalance the heterogeneity and the weak ties lack of previous knowledge between members" (Faraj et al., 2011, p. 1229). Such networks often use online media to link dispersed members (van Baalen et al., 2005). This dynamic has been referred to as indirect reciprocity or the kindness of strangers because members in such networks expect little reciprocity (Constant et al., 1996). One member

may contribute to solving another member's problem, and this contribution may benefit the helpful member only in the future (Faraj & Johnson, 2011). Following the lead of prior scholarship, our study provides a theoretical lens to explore knowledge diffusion in weakly-tied networks that have high geographic dispersion and where there is a lack of trust among network members (Brown & Duguid, 2001).

Knowledge Diffusion in a *Globally Dispersed* Supply Network

Investigating knowledge diffusion in a global supply network entails examining ties other than traditional vertical buyer-supplier ties, such as horizontal ties between suppliers and diagonal ties between a supply chain member - either a buyer or a supplier - and a third party, such as a domain expert or a not-for-profit organization) (Sloane & O'Reilly, 2013)). Recent research on knowledge diffusion through horizontal ties builds on the concept of coopetition, which means competing suppliers "increasing gains through collaborative synergy while at the same time fighting for larger shares of the gain" (Wilhelm, 2011, p. 663), and the role of coopetition in establishing market norms (Varman & Costa, 2009) and benchmarking performance (Wilhelm, 2011). Research on diagonal ties is rarer, and often do not use the term 'diagonal', but clearly states the importance of nurturing relationships with non-supply-chain stakeholders (Gold et al., 2013; Pagell et al., 2010).

Our study considers not only vertical buyer-supplier ties, but also horizontal supplier-supplier ties and diagonal ties to investigate knowledge diffusion in a contemporary, global supply network. Tie diversity poses both challenges and opportunities for a buying firm to facilitate the knowledge diffusion process (Choi et al., 2001). Our goal is to answer the RQ: *how does knowledge diffusion occur across weak ties in a globally dispersed supply network?* To build on extant diffusion scholarship, we adopt a theory elaboration approach to explore the impact of the following three drivers on knowledge diffusion within a global dispersed

supply network: prior contractual ties (*relational homophily*), co-location (*location homophily*), and *practice homophily* (the NoP view). We also elaborate the barriers to and the contextual moderators of knowledge diffusion, as pictured in Figure 1.

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RESEARCH DESIGN

Case Study Approach

This study explores the *supply network* as the unit of analysis. Because supply networks are difficult to capture in their totality due to the need for labour-intensive data collection (Dubois, 2009), we concentrated our efforts on a single, longitudinal case study of a large buying firm and its globally dispersed food supply network. We elaborated the NoP view by exposing it to the idiosyncrasies of the focused case study (Ketokivi & Choi, 2014). In doing so, we complemented previous research of knowledge diffusion in global supply networks, such as those on Nestlé, Danone, and Waitrose (see: Alvarez et al., 2010; Gold et al., 2013; Spence & Bourlakis, 2009, respectively). These studies call attention to the challenges of managing a global supply network predominantly composed of SME suppliers, and our study elaborates the NoP view to explain how knowledge diffuses (or does not diffuse) across globally dispersed SME suppliers.

The focal buying firm in our study is a UK-based food retailer (which we call 'RetailCo') that operated in 13 countries at the time of the study. We chose RetailCo because it sources a large share of its products from SMEs that are smallholder farmers from all continents, thus RetailCo has a globally dispersed supply network. In addition, RetailCo acknowledged that having little interaction with its sub-suppliers was a weakness and a challenge to be overcome. Moreover, most relationships within RetailCo's network were predominantly

arms' length, most contracts were short-term, and there was high supplier turnover. We also selected RetailCo because its scenario planning identified a steady increase in food scarcity and a subsequent increase in competition among large buying firms to secure sources of sustainable smallholder farmers. As such, RetailCo fit well with the context of a globally dispersed supply network where SME suppliers predominate.

Additionally, we selected RetailCo as our focal buying firm because in 2012 RetailCo launched an initiative to increase knowledge diffusion among its suppliers. This initiative, referred to here as the Producer Forum, consisted of an online platform where members of RetailCo's global fresh food division could discuss ideas related to enhancing operational efficiency and reducing negative socio-environmental impact. In this closed-network platform, RetailCo's employees, the global supply base (both direct and sub-suppliers), and invited experts (from academia and consulting firms) could share knowledge to improve sustainability-related practices. The Producer Forum included sub-forums, where any participant could initiate or respond to posts and all members could read all messages exchanged at any time. In addition, the Producer Forum hosted webinars, scheduled in advance, where members could attend and engage in live discussions. Finally, there were also some forums restricted to a sub-group of members and focused on specific topics such as waste, energy consumption, etc. Ultimately, the Producer Forum advanced RetailCo's need to engage with suppliers (both direct and sub-suppliers, most of which are smallholder farmers), foster sustainability, and secure long-term sourcing.

Research Methods

Data Collection. Data collection covered the first two years of the Producer Forum initiative [This manuscript is accompanied by a data supplement that offers full transparency regarding the case study timeline and the processes of data collection and data analysis]. We

adopted multiple methods to collect quantitative and qualitative data from various sources to minimize single method/respondent bias and social desirability issues (see Table 2).

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The following data were collected: (i) 26 semi-structured interviews; (ii) demographic data (2,779 members); (iii) forum data (255 forums), which includes all written communication in forums by active members (275 members); (iv) three validation workshops; and (v) observation of live webinars – these two latter sources resulted in researcher memos. These data sources provided the following insights: data source (i), the interviews, offered participants' perceptions of the initiative's aims and achievements; data sources (ii) and (iii), demographic and forum data, complemented the analysis with unbiased data; and data sources (iv), and (v), workshops and observation, allowed data triangulation and validation.

Although most interviews captured RetailCo's perspective, some key elements of the data collection process allowed us to capture an in-depth view of the suppliers' perspective as well. First, the technical team based at sourcing hubs outside the UK proved to be very critical of RetailCo's SCM practices and very knowledgeable of the suppliers' perceptions. Some members of the technical team were former suppliers before joining RetailCo, and their responses increased our understanding of the suppliers' perspective. Second, the forum data reflected high supplier participation. Finally, real-time observation of webinars provided an unbiased and direct observation of suppliers' behaviour during knowledge diffusion activities. This research strategy of multiple data sources allowed a rich understanding of network-level dynamics.

Data Analysis. We opted for a theory elaboration strategy (Ketokivi & Choi, 2014), which adopts a blend of deductive and inductive reasoning. While the social network analysis based

on demographic data and forum data is predominantly deductive, the qualitative analysis based on interviews, forum data, workshops and observation is predominantly inductive. For the inductive part of our analysis, we strictly followed the qualitative research methodology proposed by Gioia and colleagues (2012) and Pratt and colleagues (2006). This methodology ensures transparency regarding our path from raw data to propositions.

Data analysis was conducted in four main phases for four specific purposes: to identify preliminary understanding, to establish first-order codes, to determine second-order codes, and to develop theoretical propositions. NVivo software was used to code all the qualitative data in Table 2 [Please refer to the Data Supplement for a detailed account of our coding process].

Phase One: Preliminary Understanding. In phase one, we conducted the first wave of interviews (11 interviews) and received access to the first 12 months of forum data. Forum data consisted of questions and answers about specific practices, such as working conditions, energy efficiency, and water consumption. In the preliminary data analysis, we classified forum data according to the content of each post and the profile of the participants. Here, we identified that some forums were connected to follow-up forums on the same topic. As a result, some forums were combined into discussion threads. In more complex cases, multiple forums were linked and complemented by webinars. We later classified these discussion threads as *knowledge diffusion activities* (which are detailed in the Case Analysis section).

In addition, our analysis of the first wave of interviews allowed us to understand the case context. We also captured the informants' perceptions of the goals and achievements of the initiative, as well as the obstacles to forum participation. At this stage, it was clear that RetailCo had high expectations that the Producer Forum would act as a private social media and unleash a level of supplier participation much higher than experienced in RetailCo's prior initiatives. The online nature of the Producer Forum was seen as key to reach a global scale.

Most importantly, this phase showed the importance of product categories as key clusters for knowledge diffusion, which led us to associate *product category* with the NoP notion of *practice*.

Phase Two: Refining First-Order Codes. During this phase, we conducted the second wave of interviews (15 interviews), gained access to updated demographics and an additional six months of forum data, and held the first validation workshop. In this phase, we refined the first-order codes. We dropped some codes that could not be developed into more abstract and general concepts themes, despite these codes' importance to understanding the study's context. For example, we dropped codes related to RetailCo's SCM strategy and operational issues regarding language and technology. Final first-order coding was based on the method of *process coding*, which uses gerunds to denote behaviours and actions in data (Saldaña, 2009). To reach the final list of first-order codes, we revisited all data to check fit between raw data and emerging codes. Our goal for the final set of first-order codes was to maintain as much as possible the informants' voices, while reaching a set of codes that were (1) mutually exclusive, (2) complementary (to support later convergence to second-order codes), and (3) represented behaviour and actions in gerund format.

Phase Three: Social Network Analysis and Abstracting to Second-Order Codes. In this third phase, we conducted social network analysis (SNA) to further investigate the role of *practice homophily* on the evolution of the network. We chose SNA methodology because it is more suitable than traditional statistics for dyadic data, like the data in our study (Borgatti et al., 2002). We explored two methods: visual diagrams and the quadratic assignment procedure (QAP) regression. The QAP produced a regression based on social network data organized as matrices that represent whether each dyad in the network (a) had attributes in common with other dyads or (b) interacted with other dyads. Our approach was novel because the use of SNA in SCM is limited; often SCM studies lack of access to whole

networks. In this case, the Producer Forum acted as a boundary to the network and the 24 months of data we collected allowed us to conduct SNA and compare years 1 and 2 using the software UCINet [Please refer to Data Supplement for a detailed account of this procedure].

Networks are multi-layered in nature (Krackhardt, 1987). To conduct the SNA, we used the demographic data to build the layer of contractual ties (i.e., ties between RetailCo and direct suppliers or experts and between direct suppliers and their sub-suppliers). Secondly, we used forum data to build the layer of knowledge ties occurring through the online platform. We then converged first-order codes into second-order codes, moving the data to more theoretical and abstract categories. Ultimately, each second-order code represented one of four aggregated dimensions relating to knowledge diffusion: drivers of knowledge diffusion, barriers to knowledge diffusion, moderating effects on knowledge diffusion, and types of knowledge diffusion activities.

Phase Four: Developing Propositions. The final phase consisted of exposing second-order codes to one another to develop theoretical propositions. This process entailed reconciling clashing codes [such as barriers to knowledge diffusion] by formulating moderating effects that could diminish barriers and allow knowledge diffusion, thus leading to the development of four propositions. Taken together, the propositions produced a conceptual model [Please refer to Data Supplement for a detailed rationale of the interactions between propositions].

Quality Criteria. Our study has followed research ethics, interviewee checking, and triangulation protocols (Stake, 1995). During data analysis, triangulation was used to minimize misinterpretation (Stake, 1995). Our data source triangulation contrasted multiple sources of data to ensure the validity of our findings (Foerstl et al., 2010). We also triangulated and integrated interview data, forum data, and online observation to minimize social desirability bias. Our methodological triangulation was enabled by three face-to-face

validation workshops with the management team (see Table 2); this methodology refined our understanding of the case study.

CASE ANALYSIS & PROPOSITIONS

In this section, we present our analysis in the form of four propositions. Each proposition relates to one of the principal analytical concepts (aggregated dimensions) shown in Figure 2 below. Figure 2 also shows how these concepts are grounded in the coding process and based on the analytical schema proposed by Pratt and colleagues (2006).

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Drivers of Knowledge Diffusion in a Global Supply NoP

The first proposition relates to three drivers of knowledge diffusion: *relational homophily*, co-location, and *practice homophily*. We derived the first two drivers *relational homophily* and co-location – from the Community of Practice (CoP) literature and buyer-supplier relationship literature (Wenger & Snyder, 2000; Wilhelm, 2011), and we derived the third driver *practice homophily* from the NoP view and the emerging evidence from the case analysis (Brown & Duguid, 2001). We elaborated upon the CoP and the NoP views by adding the time perspective to these drivers.

Our data analysis shows that RetailCo's buyers (which had a commercial focus) and technical managers (which had a CSR/sustainability focus) were first organized according to product categories. This organization resulted from the specificities of each product category, such as technology for farming, post harvesting, warehousing, and transportation requirements. As a result, discussions on topics such as pesticides, legislation, innovation, and sustainability were often product-category-specific. Interviews show that prior to

participating in the Producer Forum, suppliers within the same product category may have conducted face-to-face initiatives to collaboratively improve practice. However, we noticed that such face-to-face initiatives were often limited due to their high cost and the Producer Forum could offer scalability to *practice homophily* (second-order code), as first-order codes below show:

> Suppliers valuing category-specific activities: "This is why the Producer Forum has to be tailored. Because what a dairy producer needs to what a vegetable farmer wants is going to be totally different. And I think the knowledge sharing can help us build sustainable contracts for the future."
> Producer Forum amplifying face-to-face practice improvement activities: "We already do that in the dairy [product category], for example. We use a third party to collect the data, then we manage and share it [locally]. Now we can expand it globally. This is the right direction for the Producer Forum" (Sourcing Director)

Triangulation of interviews and forum data showed that different drivers were having differing short- and long-term influences on the knowledge diffusion. We then conducted QAP regression to analyse the effects of the three drivers contrasting Year 1 and Year 2 of the initiative.

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Table 3 summarizes the Producer Forum's membership and contrasts the total members with the active members [those actively engaged in knowledge diffusion] in terms of three attributes: supply network role, geographic region (location), and product category (practice). Of the total members, 2,248 are suppliers (estimated as more than 30% of RetailCo's fresh food supply base), and of those suppliers, more than 1,000 are sub-suppliers. Data also shows that most of the active members were suppliers [65%, of which 46% were direct suppliers

and 19% were sub-suppliers]. Table 3 also shows the geographic diversity of the Producer Forum's membership, which included participants from 5 continents, covering 56 countries, 43 of which are developing economies.

Although commercial ties are formed at the firm level (i.e. one firm contracts with the another) and knowledge exchange ties are formed at the individual level (i.e. one individual interacts with another individual), in Figure 3 we show both layers aggregated at the level of the firm to facilitate visualization: the tiered commercial structure [left] and the knowledge exchange network [right]. In the commercial structure, as expected, RetailCo appears in the center of the commercial layer; the inner circle exhibits direct suppliers and experts [tier-1], and the outer circle comprises the sub-suppliers [tier-2]. In the knowledge exchange network, the position of each member has been defined in two ways. First, knowledge exchange position is based on degree centrality, which is measured as the number of knowledge exchanges that a member has with all other members. High-degree-centrality members are pictured closer to the center of the diagram. Second, knowledge exchange position is determined by geodesic distances, which are measured by the level of exchange between members such that members with higher levels of exchange are closer to each other. Figure 3 visually shows low level of overlap between knowledge exchange ties and commercial ties.

Table 4 presents both the descriptive and inference statistics (QAP regression). First, co-location is low (Year 1: 39.4%; Year 2: 41.7%) and although it is significant in Year 1, it becomes non-significant in Year 2. This finding means that most knowledge exchange ties occur across different geographic regions, and in the long-term co-location is not a predictor of knowledge exchange. Second, *relational homophily* is very low (Year 1: 14.0%; Year 2: 16.4%), with the results indicating that although this influence is initially significant, it becomes non-significant in Year 2, therefore a driver of long-term knowledge diffusion. Finally, the results indicate that *practice homophily* is high (Year 1: 76.4%; Year 2: 74.7%)

and although non-significant in Year 1, it becomes significant in Year 2. This result shows that not only do most knowledge exchange ties occur within product categories [practices], but also *practice homophily* is a significant long-term predictor of knowledge diffusion. Put together, results indicate that the effects of prior contractual ties [*relational homophily*] and co-location on knowledge diffusion are experienced in early stages, but that they are short-term and diminish over time. In contrast, engagement in similar practices was found to be the most significant long-term driver of knowledge diffusion, despite lack of prior contractual ties and high geographic dispersion.

The data also showed the sparse nature of the RetailCo network was actually seen as an asset: "if you are a small grower in the middle of South America, the chances [are] that you have never visited production [facilities] in Spain or Italy or Greece or South Africa" (PF Champion). Moreover, the data revealed that shared practices motivated suppliers to exchange knowledge with unknown suppliers and even to correct wrong information. As one supplier states, "if a supplier I don't know asks a question and somebody gives an irrelevant, incorrect answer, leading the person in the wrong direction, then I normally try to answer as quick as possible" (Supplier, South Africa). Thus, the analysis shows that knowledge diffusion in a globally dispersed supply network is initially predominant within safe zones characterized by prior contractual ties and co-location of network members, but over the long-term it is distributed through common practices. Given these findings, we developed the following propositions:

Proposition 1a: In a *global supply NoP*, prior contractual ties (*relational homophily*) and co-location (*location homophily*) drive knowledge diffusion, but this effect diminishes overtime.

Proposition 1b: In a *global supply NoP*, *practice homophily* drive knowledge diffusion, an effect that will increase overtime.

Barriers to Knowledge Diffusion in a Global Supply NoP

Figure 2 depicts first-order codes and how they represent the barriers to knowledge diffusion in a *global supply NoP*. *These barriers* were not in the original intra-organizational NoP framework but have been elaborated within our analysis. Specifically, we found barriers that exist in both supplier-supplier and buyer-supplier ties.

The first barrier to knowledge diffusion lies in horizontal supplier-supplier ties. Suppliers were resistant to participate in the Producer Forums since they wanted to preserve their competitive advantage, they lacked confidence in their own current performance, and they were inexperienced in collaborating with other suppliers. Put together, these three dimensions of resistance in supplier-supplier ties converged to a second-order code, which we labelled "fear of coopetition." Our interviews with the buying firm as well as with the suppliers all show fear of coopetition's negative impact on the formation of supplier-supplier knowledge exchange ties, thus our study shows fear of coopetition initially created a significant challenge for the Producer Forum initiative.

> Researcher Memo [Attending webinar on carbon emissions]: "All participants have reported their numbers, but interaction is very limited. The webinars coordinators [RetailCO manager and Expert] are more vocal than suppliers. The expert is making an effort to engage suppliers, but he seems too technical and a bit boring. If numbers are provided but there is no proper discussion, this is a significant challenge for the initiative."

These results echo those of other studies. Fear of coopetition is a well-established barrier to supplier-supplier collaboration (Pathak et al., 2014), with suppliers often being suspicious when a buying firm requests them to collaborate with competing suppliers (Choi & Wu, 2009; Touboulic et al., 2018). However, our research adds new insights into why suppliers resist collaboration. In particular, we were surprised to find suppliers' lack of confidence is a reason to avoid supplier-supplier collaboration. As described by a technical manager:

"sometimes when they [suppliers] know how to answer questions and they want to help, still if they are not confident about what they know, they do not reply to posts. They just read the posts and do nothing." (Technical Manager, Greece). We combine these elements of coopetition to propose the following:

Proposition 2a: In a *global supply NoP*, fear of coopetition can hinder knowledge diffusion between same tier members, particularly supplier-supplier ties in a global supply network.

The second barrier to knowledge diffusion relates to vertical buyer-supplier ties and the phenomenon of supply chain disintermediation. Direct suppliers feared that RetailCo would use the forum to start buying directing from their sub-suppliers. As the quote below shows, this fear was partly merited as the blow quotes indicate:

> Direct suppliers fearing elimination by the buying firm: "Direct suppliers are concerned about the transition and that the firm [RetailCo] will start buying directly from these farms instead of using them as the broker and as the intermediary." (PF Manager)
>
> "There is a certain interest for people to protect their own position. (…)So you know, when we talk about in some cases 'going direct', we mean that. But equally, we will also keep agents if it is the right thing for customers and the right things for producers. We can be flexible." (Commercial Director)

Fear of elimination led some direct suppliers to be hesitant to encourage participation by their sub-suppliers as can be seen in the quote below:

> Direct suppliers hesitating to encourage sub-supplier participation: "Sometimes the relationship between the middlemen [direct suppliers] and the producers [sub-suppliers] might not be a good one because of commercial pressures. And so I have a bit of a problem in that the middlemen might not want some of their producers participating in the Producer Forum, because they might actually fear that if they let them on, or if they start becoming very active, that they might start

raising, I don't know, different concerns. (…) Some middlemen select producers they have the best relationship with, so we only see part of the supply chain." (Technical Manager 12, UK)

In order to triangulate the above perception, we have analysed the proportion of active sub-supplier that have been brought to the initiative by active intermediates (88%) and those that have adhered to the Producer Forum without participation of their intermediates (12%). The data reveals concern of elimination was real - there was some level of disintermediation - but the data also shows suppliers respond to this threat in different ways; therefore, our study suggests the barrier was present but not determinant.

We converged these two elements that reflect direct suppliers' concern of exclusion by the buying firm and their actions of not engaging their sub-suppliers (or at least filtering which sub-suppliers to invite) into the term "fear of disintermediation", a concept that is absent in the original NoP framework. We propose that in a *global supply NoPs* there is fear of disintermediation that is not present in intra-organizational NoPs. Specifically, we offer the following proposition:

Proposition 2b: In a *global supply NoP*, fear of disintermediation can hinder knowledge diffusion since direct suppliers may prevent participation of their sub-suppliers in a global supply network.

Contextual Moderators of Knowledge Diffusion in a Global Supply NoP

We also identified three moderators that can dampen the influences of the two barriers that we identified in P2: one at the vertical dimension (buyer-supplier), the second at the horizontal dimension (supplier-supplier), and the third at the diagonal dimension (expert-buyer/supplier). The first moderator of supplier fears is *procedural justice*, which refers to how the procedures that the buying firm uses to define rules of participation in the initiative (Korsgaard et al., 1995). For example, when analysing multiple sources of data, we noticed

that RetailCo's inclusive approach of the Producer Forum diminished the influences of both barriers – fear of co-opetition and fear of disintermediation – to knowledge diffusion. Specifically, when RetailCo invited suppliers to take part in a Steering Committee to increase their voices in the decisions about the Producer Forum thus improving transparency and self-direction – in their words "to ensure the neutrality and credibility of the Producer Forum" (Technical Director) and "to get better guidance and direction from the supplier themselves regarding how to conduct the Producer Forum" (PF Manager).

We also observed *procedural justice* in other RetailCo's decisions. Specifically, we noticed it when RetailCo would restrict the type of performance data allowed to be disclosed, forbidding the disclosure of suppliers' pricing and cost structures and would ensure data confidentiality by anonymizing individual supplier data in the forum reports, as below:

> "We ask suppliers to upload their performance so we can give them 'a league table of results'. And we then confidentially come back to them and compare their performance with benchmarking references" (Sourcing Director 3).

Based on these findings, we suggest *procedural justice* is a generative approach in a *global supply NoP* that can help alleviate fears related to supplier-supplier coopetition and buyer-supplier disintermediation (both P2a and P2b). As a result, we propose the following:

Proposition 3a: In a *global supply NoP*, a buying firm's assurance of *procedural justice* alleviates the negative effects of the fear of coopetition and disintermediation on knowledge diffusion.

The second moderator, geographic dispersion, emerged from our data analysis of supplier-supplier interactions. The data shows global dispersion seems to create opportunities for suppliers to "learn best practices from other parts of the world" (PF Manager) and to access "lots of different cultures and lots of different capabilities within the supply base" (Technical Director). In addition, geographic dispersion allows for knowledge exchange when buyers

make anticyclical purchasing decisions, which are less threatening than typical purchasing decisions. For example, RetailCo engages in anticyclical buying behaviour when it buys from SME suppliers in different regions during different periods of the year. Because "Spanish citrus growers harvest at a completely different time than South African citrus" (Technical Manager 5), RetailCo buys from both suppliers in different seasons, and these purchases are perceived by both suppliers as being non-competitive. Consequently, suppliers from these different regions do not consider each other as direct competitors, thus these suppliers are more likely to exchange knowledge (as seen in Table 4 co-location is below 42%).

In the SCM literature, coopetition results from suppliers who serve the same customer deciding to balance cooperating and competing tensions and determining when to share knowledge and when to protect it (Carnovale & Yeniyurt, 2014). As a result, SCM scholarship suggests geographic dispersion [and weak ties resulting from it] is positive when supporting innovative knowledge, but negative on the diffusion of existing knowledge (Carnovale & Yeniyurt, 2015; Nair et al., 2016). Conversely to previous research, we identify a positive impact: geographic dispersion can diminish competitive tensions among suppliers. As a result of our observations, we propose the following proposition:

Proposition 3b: In a *global supply NoP*, supplier geographic dispersion alleviates the negative effects of the fear of coopetition on knowledge diffusion.

During the course of the study, RetailCo recruited non-supply chain member experts from consulting firms and academia and fostered their participation in the Producer Forum. From our analysis of the role of non-supply chain members, we were able to identify the third moderator of knowledge diffusion – leading non-supply chain members which we call *'nexus members'* – which relates to the diagonal axis. This moderator occurred *nexus members* encouraged supplier participation in the Producer Forum:

> "RetailCo's global reach helps to access experts who can help producers. If you are a small producer in South Africa, for example, you might not know who the best post-harvest expert in your product category is, but we can find him, for example, in Chile, and bring him to the network" (Technical Director).

One example of nexus member leadership was identified on the topic of shelf-life improvement, where an expert from the UK has taken the lead role in the diffusion of relevant knowledge, attracting suppliers from UK, Chile and Spain. The benefits of expert participation is largely acknowledged: "the expert seminar on shelf-life improvement was very successful because it related directly to what we are producing. (…) that was a big success" (Technical Manager 7).

In this study, we note that *nexus members* reduce the salience of the focal buying firm, moderating suppliers' fear of coopetition and disintermediation, motivating suppliers by sharing knowledge that would not otherwise be unavailable to them. Forum data shows that often these *nexus members* joined the network as peripheral members, but they later become leading protagonists of knowledge diffusion. Therefore, in the context of a *global supply NoP*, we propose that the emergence of *nexus members* alleviates suppliers' fears [P2a and P2b] because suppliers see the value of engaging in the online platform to benefit from the *nexus members'* knowledge. We thus posit the following proposition:

Proposition 3c: In a *global supply NoP*, *nexus members* other than the buying firm alleviate the negative effects of the fear of coopetition and disintermediation on knowledge diffusion.

Characteristics of Knowledge Diffusion in a Global Supply NoP

As previously discussed, the NoP lens suggests *practice homophily* is the key condition for knowledge diffusion in the absence of prior contractual ties and co-location, but little is known about how explicit and tacit knowledge are diffused in an NoP. We address this gap in

scholarship by identifying two types of online-based knowledge diffusion activities in a *global supply NoP*. Knowledge diffusion activities in this inter-firm context differ from the those in intra-firm NoPs (Brown & Duguid, 2001) as well as from those identified in dense supply networks, such as the Toyota case (cf Dyer & Nobeoka, 2000).

To develop our fourth proposition, we juxtaposed the two types of knowledge diffusion activities we observed in the Producer Forum – as seen in Table 5.

---------- INSERT TABLE 5 APPROX HERE ----------

The first type of knowledge diffusion activity we observed we labelled *broadcasting forum*; this activity entailed identifying best practices during site visits to suppliers and face-to-face-workshops, and then producing videos and/or reports to broadcast in the Producer Forum. This activity helped RetailCo "build a more coherent communication package" (Sourcing Director) by reaching and keeping the total membership – even members who took a passive approach in the Producer Forum – informed about best practices. Each month, several broadcasting forums were initiated. Despite their broad reach, knowledge diffusion in these broadcasting forums was basically limited to explicit knowledge.

The second form of knowledge diffusion we observed we called *action groups*, which aimed at diffusing tacit knowledge. These action groups consist of long-term groups to address specific issues, such as waste, carbon emissions, or water efficiency. In the Producer Forum, action groups were formed with guidance from a Steering Committee that included representative from suppliers. Online supplier survey responses helped identify key themes for the action groups, which combined a mix of forums and webinars. Forums provided asynchronous knowledge diffusion and became a library of best practices that could be consulted at any time; webinars provided synchronous knowledge diffusion that enabled live discussions of chosen themes.

One example of action group is the one on carbon reduction. Through this action group, peer suppliers worked together to implement a software for tracking carbon emissions, determining their own emissions, and comparing their results against benchmark averages. In this action group, suppliers reported reduction of their carbon footprint, increased knowledge of best practices of using low-carbon energy sources, and increased understanding of the benefits of low-carbon fertilizers. RetailCo organized five action groups in the first year and twelve action groups by the end of the second year.

Broadcasting forums and action groups are therefore complementary activities. These two activities vary in terms of duration, breadth, and depth [tacitness]. Whereas broadcasting forums 'cast the net' to attract suppliers' attention, action groups allow a platform for long-term knowledge diffusion. We identified that suppliers often initiated their knowledge diffusion participation through broadcasting forums, and then engaged in action groups, showing us that the two activities complement each other in a *global supply NoP*. We hence pose a proposition to reflect the uniqueness of knowledge diffusion in a *global supply NoP*:

> **Proposition 4:** In a *global supply NoP*, complementary online activities, namely *broadcasting forums* and *action groups*, support knowledge diffusion around shared practices, despite a lack of relational ties and high geographic dispersion. These two activities differ in breadth [reach] of knowledge diffusion and depth [tacitness] of knowledge, thus they offer complementary opportunities to supplier participation.

Ultimately, our case analysis led us to elaborate the NoP view through four sets of propositions and to characterize a *global supply NoP* (Figure 4).

---------- INSERT FIGURE 4 APPROX HERE ----------

CONCLUSIONS

Theoretical Implications

Our study expands the NoP view, originally developed in an intra-organizational context, to an inter-organizational context of a globally dispersed supply network. We offer a number of implications for SCM research generally and global supply network research in particular. Previous research has evaluated the role that time plays in the development of dense supplier clusters such as the Toyota supply network (cf Dyer & Nobeoka, 2000) and in the spread of innovations in supply networks (Nair et al., 2016). We elaborate the NoP view by empirically exploring the role of time in the development of an inter-organizational NoP. Our study explains how weakly linked members can effectively diffuse knowledge over time (Faraj et al., 2011; van Baalen et al., 2005). Besides confirming the applicability of the NoP view in the context of a global supply network, this paper also advances the incipient research on gracious buyer-supplier relationships, that is, relationships based on weak but collaborative ties (Kim & Choi, 2015).

From a NoP view, diffusion of knowledge is contingent on *practice homophily*, outweighing other influences (Brown & Duguid, 2001; Wenger, 1998). As such, a lack of relational ties and geographic dispersion do not prevent knowledge diffusion as long as these attributes are counter-balanced by *practice homophily*, which encourages members exchange knowledge due to their shared interests in improving common practices (van Baalen et al., 2005). Confirming these NoP theoretical predictions and in contradiction to prevalent SCM research, our results show that the effect of both prior contractual ties [*relational homophily*] and co-location [*location homophily*] diminish in the long-term, while shared practices [*practice homophily*] plays a sustainable role in motivating the formation of knowledge exchange ties in a global supply network (Cheng et al., 2008; Hoejmose et al., 2012).

Our study also advances SCM research on supplier-supplier coopetition (Varman & Costa, 2009) and buyer-supplier disintermediation (Shunk et al., 2007). While both concepts have been studied before, their influences on knowledge diffusion in an online platform has only been marginally explored (Baglieri et al., 2007). Our study is important because it addresses the direct supplier concern that knowledge platforms may make their roles redundant, allowing buying firms to eliminate them from the supply network (Choi & Wu, 2009). Our findings not only confirm such threats, but also show how buying firm *procedural justice*, high geographic dispersion, and *nexus members* can alleviate the fears of coopetition and disintermediation, thus shedding new light on how to overcome such barriers.

We confirm that *procedural justice* based on neutrality (Chen et al., 2004) and confidentiality (Wilhelm, 2011) fosters coopetition and benchmarking activities across suppliers. Previous research has shown that *procedural justice* [as a means to knowledge diffusion] has a higher impact than distributive justice [as an ends of knowledge diffusion] on supply network partners (Griffith et al., 2006). We confirm that *procedural justice* is particularly relevant when studying firm knowledge exchange behaviours in a weak-tie context where arm's length relations prevail (Colquitt, 2001). In a globally dispersed supply network, *procedural justice* can overcome the inherent lack of trust among suppliers as well as any ineffective enforcement strategy when facilitating knowledge diffusion through online exchanges (Cai et al., 2013); thus, we echo Kim and Choi (2015) criticism regarding the limits of a dichotomized view that suggests trust and enforcement are the only two strategies for managing suppliers.

In addition, contrary to studies that frame geographic dispersion as a barrier to knowledge diffusion (Hall & Matos, 2010), we found that geographic dispersion helps relieve suppliers' fear of coopetition. The geographic distance weakens supplier-supplier ties by reducing the visibility and salience of individual suppliers. As a result, suppliers do not perceive each

other as threats. Thus, there is a higher potential for supplier-supplier coopetition in a globally dispersed supply network than has previously been acknowledged. To the best of our knowledge, this bright side of geographic dispersion has not been identified previously.

Additionally, this study builds on prior SCM research that posits that low-tier suppliers who are invisible to a buying firm can play a critical role in the supply network (Yan et al., 2015). The extant research also has discussed the importance of diagonal ties between a buying firm and third-party experts, such as professional bodies (Gold et al., 2013) and consultants (Nair et al., 2016), on knowledge diffusion processes. Advancing this steam of work, we show that diagonal ties between *nexus members* and other supply network members can help overcome the fear of disintermediation by reducing the salience of the focal buying firm as a central player. The inclusion of non-competitive diagonal buyer-expert and supplier-expert relationships is an important step towards contextualizing the *global supply NoP* view in sparse, globally dispersed supply networks.

Finally, the NoP literature has mostly focused on *why* knowledge diffusion occurs within NoPs (Brown & Duguid, 2001). Contributing to this literature, our results show *how* knowledge diffusion occurs within globally distributed NoPs. We identified complementary knowledge diffusion activities – broadcasting forums and action groups – that allow suppliers to opt into different levels of engagement to best match their practice-improvement goals. These findings relate well to the emerging SCM literature that adopts an information processing theory (IPT) view (Busse et al., 2017). From an IPT view, action groups and broadcasting forums, the two complementary activities can be seen as two different types of uncertainty-reducing mechanisms that can foster knowledge diffusion in a *global supply NoP*. Since action groups' use of rich and two-way communication media and are composed of diverse organizations, action groups offer high information processing capacity [in the IPT view], or in other terms, allow higher leakiness and diffusion of tacit knowledge [in the NoP

view]; while a broadcasting forum is a fast and low-cost way of spreading information, but the diffused knowledge is mostly explicit and thus less sticky. Our study shows action groups focus on depth of diffused knowledge, while broadcasting forums focus on breadth of diffused knowledge. Altogether, these findings advance our understanding of knowledge diffusion in a *global supply NoP* through bridging the IPT and NoP literature.

Managerial Implications

Our study offers key recommendations to SCM managers. We propose that that buying firms aiming for global knowledge diffusion should not restrict their strategy to building long-term bonds with specific suppliers; rather, they should also consider setting a *global supply NoP*. More specifically, we call managers' attention to some distinctive features of a successful *global supply NoP*. First, managers must foster *procedural justice* to produce a perception of fairness across the supply network. Second, managers can benefit from the positive side of geographic dispersion within each purchasing category to catalyse knowledge diffusion. Third, managers should invite non-supply chain members, especially those with expertise on specific product categories to participate in the NoP. Fourth, managers should ensure an adequate online media infrastructure that permits the combination of both short-term/wide broadcasting of explicit knowledge and long-term/in-depth groups on specific topics, blending asynchronous and synchronous online knowledge diffusion. Taken together, this list of best practices can allow weak ties to be effective conduits of knowledge diffusion in a globally dispersed supply network. As these suggestions illustrate, this research offers an alternative SCM approach to harness the benefits of a globally dispersed supply network and drive supplier participation within it.

Limitations and Future Research

Our paper takes a single-case, longitudinal view of how knowledge diffuses in a complex global supply network. The single-case approach has some limitations that must be considered. The first limitation relates to control variables: multiple cases and surveys can control industry context, firm size, and other aspects that a single case cannot address (Eisenhardt, 1989). Hence, future research couldcontrast our findings with other exemplary cases, such as those in high-technology and concentrated industries, where geographic distance may cease to play a key role in knowledge diffusion and coopetition may prevent the emergence of a *global supply NoP*. Cases with stronger competition dynamics could reveal further control variables for knowledge diffusion within supply networks.

The second limitation is that single-case studies can produce a theory that is rich in detail but lacking in simplicity (Van de Ven, 2007). Moreover, the idiosyncratic boundaries of a single setting can lead to narrow theoretical developments. As an example, this case study does not contrast economic and non-economic reasons for supplier participation. In dense supplier clusters, collaboration is often influenced by non-economic logics based on culture, values, and beliefs (Wu & Pullman, 2015). Future studies could delve deeper into the different logics for supplier participation in a globally dispersed context.

We propose that *global supply NoPs* can be effective alternatives to both dense supplier clusters and to the adversarial brinkmanship of most dominant buying firms, which are increasingly criticized by public opinion (Balch, 2016). *Global supply NoPs* can be efficient because sparse supply networks can be managed at lower costs than dense and highly-connected supply network structures (Mena et al., 2013). Extant scholarship suggests that the sustainability challenges can be only solved by partnering with diverse stakeholders (Beske et al., 2014; Brockhaus et al., 2013; Pagell & Wu, 2009; Pullman & Dillard, 2010). We propose that *global supply NoPs* can be one effective path to answer to sustainability challenges.

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TABLE 1
Social Network Theory in SCM Research (Exemplary References)

Performance as independent variable (Social capital)	Diffusion as independent variable (Homogeneity)
Relational capital (Trust) - Cheng et al. 2008 - Hoejmose et al. 2012 - Theißen et al., 2014 **Structural capital** - Carnovale & Yeniyurt, 2014 - Kim et al., 2015 - Kim et al., 2011	**Communities of Practice** - N/a - **Networks of Practice** - N/a -

TABLE 2
Summary of Data Collection and Data Manipulation

Data type	Data source / Data volume / Data code		Data analysis
	UK-based RetailCo members	**non-UK based RetailCo & other network members**	
26 Semi-structured interviews [average 41 min]	Headquarter (79,119 words): 1 Director (D01) 3 Commercial directors (C01-03) 2 PF Manager (T01-02) 1 Technical director (T04) 2 Buyers (C04-05) 5 Technical managers (T05-07, 12, 14)	Sourcing hubs (21,666 words): 1 PF Champion (T03) 5 Technical Managers (T08-11, 13) Suppliers and Experts (21,256 words): 4 Suppliers (S01-04) 1 Expert organization (E01)	▪ Imported to NVivo for qualitative coding
Demographic data [Download, covering 24 months]	Demographics on all members subscribed to the Producer Forum in an Excel chart covering: name, job position, company, supply network role, country, product category [2,779 members]		▪ Classification according to three attributes: (1) product category (practice); (2) geographic region; and (3) supply network role ▪ Contractual network layer, i.e., a

			matrix of "0" and "1", where "1" means a contract [eg1 RetailCo - Expert organization; eg2 Direct supplier - Sub-supplier]
Forum data [Download, covering 24 months]	100% of all written data in 24 months in an Excel chart including for each post: date, sender, post title, content [255 forums, F001-255, total of 207,102 words]		▪ Knowledge network layer, i.e., a valued matrix, where a value in each cell means the number of interactions between A and B in the forums [e.g., If A and B have interacted in three forums, the value is "3"] ▪ Text shared in forums imported to NVivo for qualitative coding
3 Validation workshops [120 min each]	1 PF Manager (T02) 1 Technical director (T04)	1 PF Champion (T03)	▪ Triangulation with other data sources
Direct observation [Online access during 18 months]	Access to the online platform for 24 months for real-time observation of forums and live webinars		▪ Triangulation with other data sources

TABLE 3
Producer Forum Demographics: Active versus Total Membership Profile (24 months)

Product category	Total	%	Active	%
1. General	283	*10%*	38	*14%*
2. Produce	1,453	*52%*	208	*76%*
3. MFPE	412	*15%*	17	*6%*
4. Dairy	631	*23%*	12	*4%*

Supply network role	Total	%	Active	%
1. RetailCo	430	*15%*	79	*29%*
2. Expert	101	*4%*	18	*7%*
3. Direct supplier	1,130	*41%*	126	*46%*
4. Sub-supplier	1,118	*40%*	52	*19%*

Geographic region	Total	%	Active	%
1. United Kingdom	1,789	*64%*	167	*61%*
2. Continental EU	437	*16%*	30	*11%*
3. Africa	262	*9%*	38	*14%*
4. America	162	*6%*	20	*7%*
5. Asia	129	*5%*	20	*7%*

	Total	Active	%
Members	2,779	275	*10%*

TABLE 4
Descriptive (Homophily Percentages) and Inference (QAP Regression) Statistics: Year 1 versus Year 2

Independent matrix	Overlap % (QAP coefficient)		Results	Classification
	Year 1	Year 2		
Co-location (Location homophily)	39.4% (0.03*)	41.7% (-)	Most ties occur across different geographic regions. Although initially significant, geography becomes non-significant in Year 2.	Short-term influence, Long-term indifference
Contractual ties (Relational homophily)	14.0% (0.05*)	16.4% (-)	The large majority of ties do not occur between actors of the same firm or with a contractual tie. Although initially significant, the contractual structure becomes non-significant in Year 2.	Short-term influence, Long-term indifference
Practice homophily	76.4% (-)	74.7% (0.05**)	Most ties occur between actors of the same product category and this becomes significant in the Year 2.	Long-term influence

*Notes: Overlap % indicate the overlap between independent matrices and the knowledge exchange matrix. QAP coefficients are shown in parenthesis for significant tests at * 5% and ** 1%. R^2: 0.05 (Year 1) and 0.08 (Year 2).*

TABLE 5
Knowledge-Diffusion Activities in a Global Supply NoP

Knowledge-diffusion characteristics	Type 1: Broadcasting forum	Type 2: Action group
Knowledge diffusion as a mix of two **reinforcing** activities: broadcasting forums and action groups.	**Over 120 per year, ad-hoc** Broadcasting forum is a one-way tool when it captures top suppliers' cases. For example, a video detailing a best practice related to dairy farm management and mobility (F059).	**5-12 per year, continuous** Action groups are long-term groups mobilized for a shared goal based on a mix of forums and webinars. For example, the Cool Farming Tool action group fosters the implementation of software to track carbon emissions and measure the carbon footprints of crop and livestock products (F010, F057, F062, F220, F222).
Knowledge diffusion varies in **breadth** (reach) of knowledge diffusion.	**High breadth** Total members: 2,779 after two years.	**Low breadth** Active members: approximately 10% of total members.
Knowledge diffusion varies in **depth** (tacitness) of knowledge.	**Low depth** Broadcasting and building a library of best practices based on asynchronous explicit knowledge diffusion.	**High depth** Mix of forums (asynchronous) and live webinars (synchronous), which allow tacit knowledge diffusion.

FIGURE 1
Theory Elaboration: NoP View in a Global Supply Network

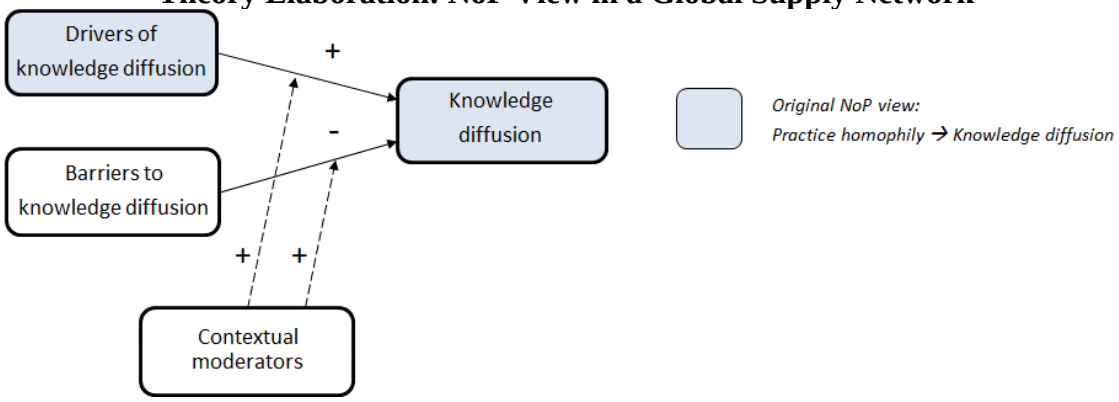
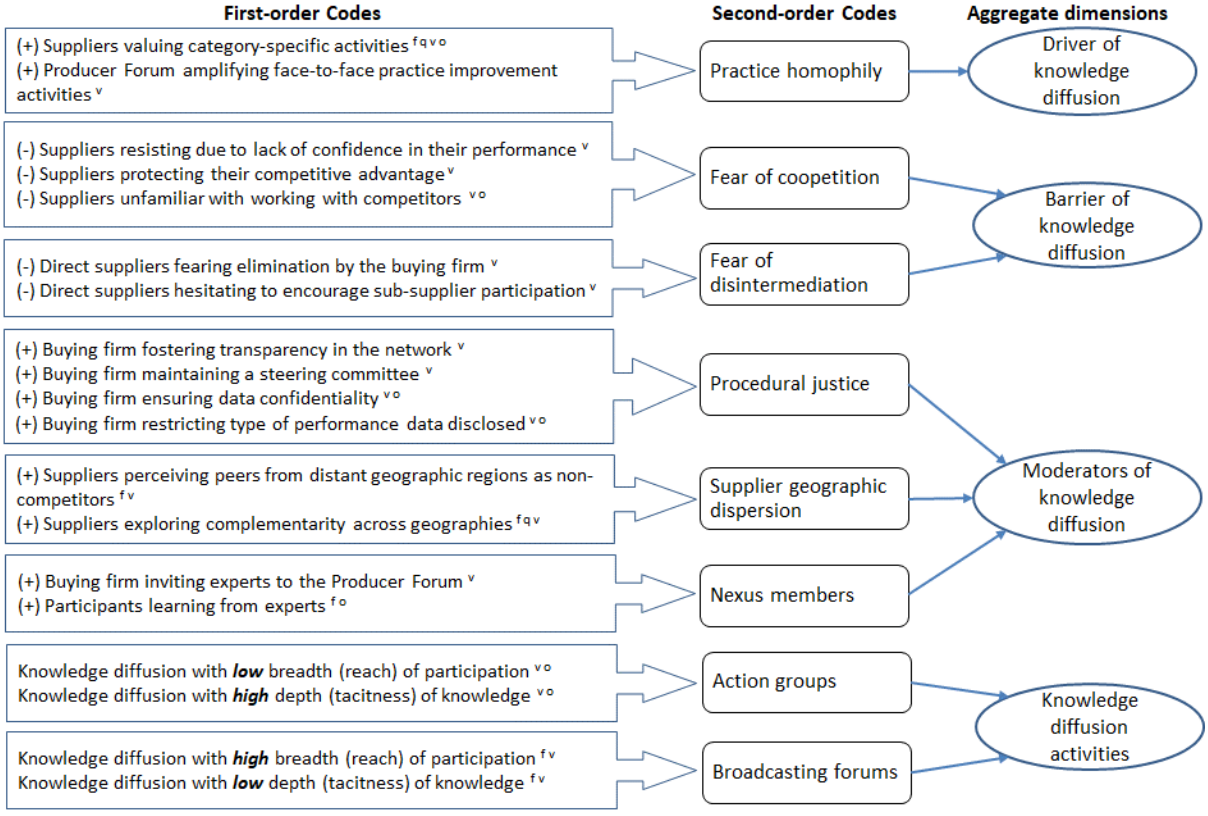
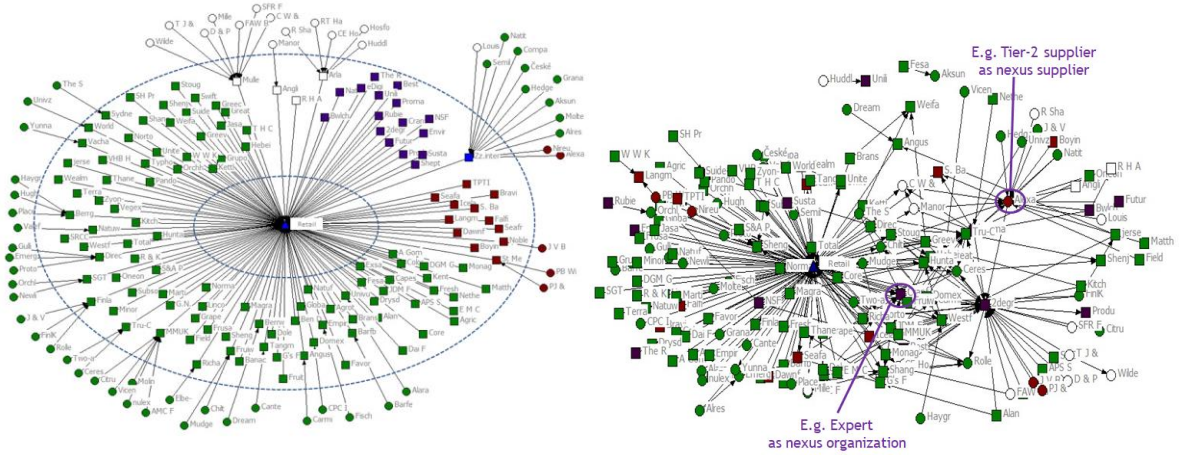


FIGURE 2
Data Analysis Structure



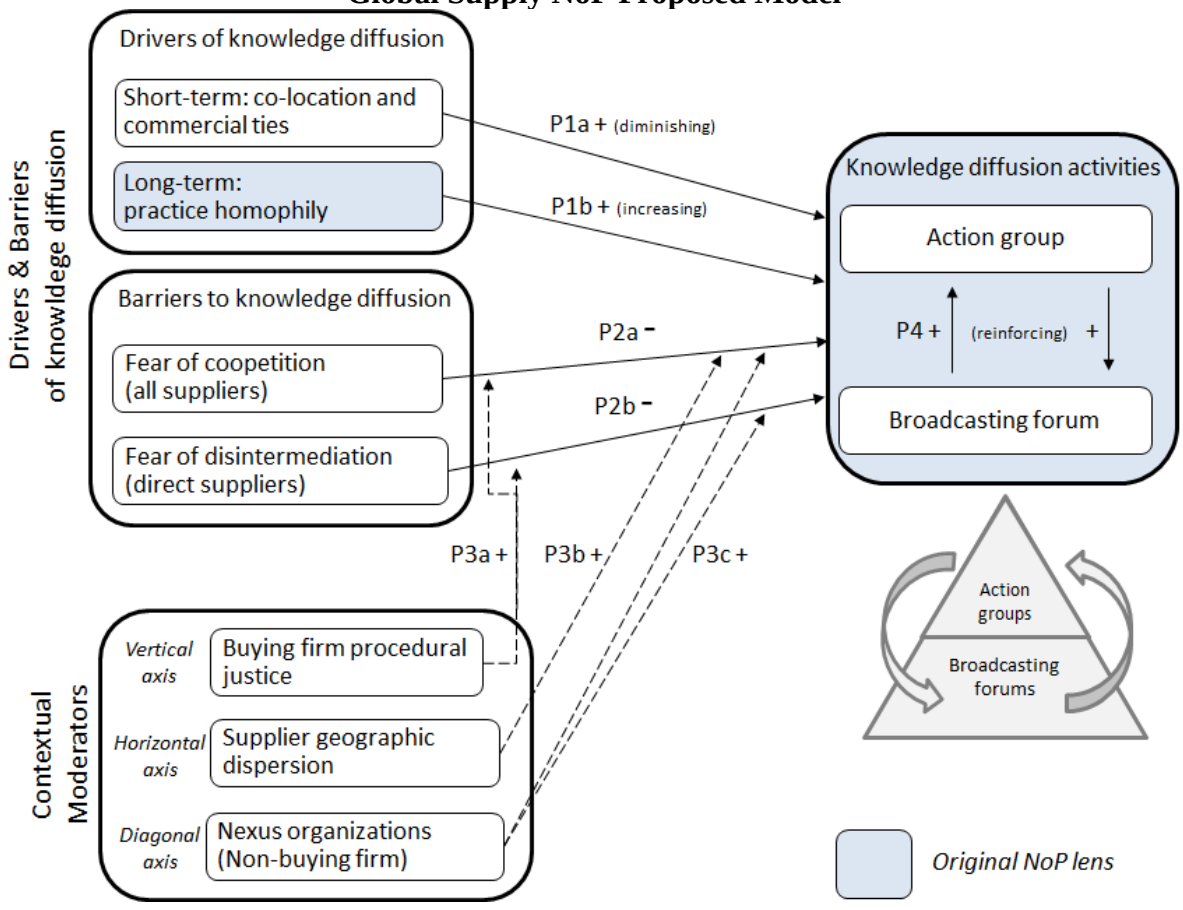
Notes: For the First-order codes, all codes derived from the interviews. We show in superscript when data coding was supplemented by: "f" forum data; "q" QAP regression; "v" validation workshops; and "o" online observation, as proposed by Pratt et al. (2006).

FIGURE 3
Network Layers: Commercial (left) versus Knowledge Exchange (right) Networks



Notes: Node color - Blue: General; Green: Produce; Red: MFPE; White: Dairy; Purple: Experts
Node shape - Triangle: RetailCo; Square: Tier-1 supplier/Expert; Circle: Tier-2 supplier

FIGURE 4
Global Supply NoP Proposed Model



DATA SUPPLEMENT to MANUSCRIPT:

KNOWLEDGE DIFFUSION IN A GLOBAL SUPPLY NETWORK: A NETWORK OF PRACTICE VIEW

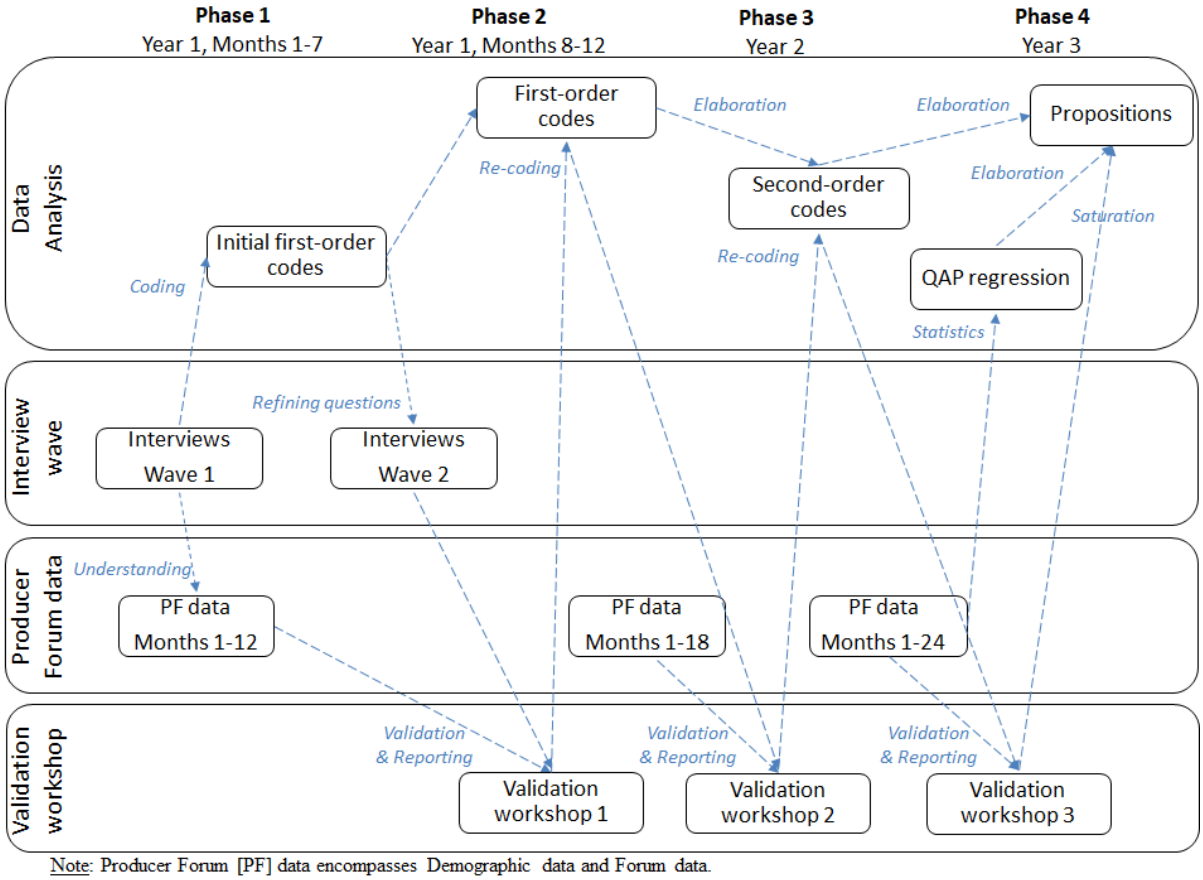
INTRODUCTION TO THE DATA SUPPLEMENT

The aim of this Data Supplement is to offer transparency to and replicability of this research project. This study utilized a large number of data processes and required multiple steps to reach the final results; it involved an innovative mix of qualitative data analysis and social network analysis (SNA) in a network-level case study. To offer transparency this supplement provides a case study timeline, offering readers a longitudinal perspective of how the research was conducted. To aid in replicability, we offer detailed, step-by-step procedures for both the qualitative analysis and the quantitative SNA techniques we used.

The timeline is organized in four phases, following the pattern proposed by Gioia and colleagues (2012). In Phase 1, we conducted the first wave of interviews and started to analyse demographic data and forum data, which resulted in initial first-order codes. Phase 2 involved a second wave of interviews and a validation workshop for refining first-order codes. In Phase 3, we finished the data collection, which resulted in a total of 24 months of forum data. In this phase, we also developed second-order codes and conducted final SNA analysis. The final phase (Phase 4) focused on the development of the propositions derived from connecting second-order codes. Figure DS1 below synthesizes the workflow of our data analysis and theory elaboration phases.

FIGURE DS1

Data Analysis Workflow



Note: Producer Forum [PF] data encompasses Demographic data and Forum data.

Figure DS1 shows how the research project evolved across the four phases and which set of data was used in each phase. It outlines the process of moving from preliminary

understanding of the context, to developing first-order codes, developing to second-order codes to conducting QAP regression, and finally to developing propositions.

PHASE 1: PRELIMINARY UNDERSTANDING (Year 1, Month 1-7)

Data Collection

In Phase 1, we conducted the first wave of interviews, initiated manipulation of Producer Forum data, and received access to observe live webinars. Specifically, we conducted the following interviews and collected the following data:

- First wave of interviews (11):
  - 1 Sourcing Director (D01)
  - 2 PF managers (T01-02)
  - 1 Technical director (T04)
  - 5 Technical managers (T05-09)
  - 1 PF champion (T03)
  - 1 Expert (E01)
- Producer Forum data (12 months):
  - Demographic data [static data]: name, job, company, and details of the company, including product category, country, supply network role, and contractual ties
  - Forum data [dynamic, written posts]: date, sender, post title, and post content of each post
- Observations of live webinars as silent observers [research memos]

The selection of first-round interviewees was based on the RetailCo's advice about key informants, including the Producer Forum management team, which was composed of the PF Managers (T01-02), the PF Champion (T03), and the Technical Director (T04), and the Sourcing Director and Technical managers that were involved with the initiative. Therefore, the first wave was concentrated on management and 'heavy users'. UK-based interviews were conducted face-to-face (8), and interviews for individuals outside the UK were conducted via Skype (3). All interviews were recorded, transcribed, and sent to interviewees

for review; only one interviewee made minor amendments to the transcript. Qualitative data analysis was supported by NVivo software, producing first-order codes.

In order to complement interviews with unbiased data, the project had access to Producer Forum data for the first 12 months of the initiative. This data covered demographic data and forum data, shared in two separate Excel files produced by the RetailCo's IT department.

The first file contained the demographic data for the 1,485 individuals who participated in the first 12 months of this study. Of the total participants, 115 actively posted to the forums.

This demographic data was used for two purposes: to identify contractual ties (i.e., to determine who supplies to whom) and to classify members according to three key attributes: product category, geographic region, and supply network role. Specifically, these attributes broke the demographic data into the following data sets:

- Product categories: (i) Produce (fruits, vegetables, and seeds); (ii) MFPE (meat, fish, poultry, and eggs); (iii) Dairy (milk products); and (iv) General (all non-product areas of expertise, such as logistics and legal action).
- Geographic regions reflecting RetailCo's sourcing hubs: (i) UK; (ii) Continental Europe; (iii) Africa; (iv) the Americas; and (v) Asia.
- Supply network roles to identify whether members are from: (i) RetailCo; (ii) Direct suppliers; (iii) Sub-suppliers; and (iv) Expert organizations, including universities, consulting firms, and associations.

The second file showed the dynamic forum data, which contained each post made in the Producer Forum as well as research memos from the Produce Forum live webinars. The live webinars were scheduled and announced by RetailCo in advance. RetailCo authorized the lead researcher to login to the Producer Forums and join the webinars as a silent observer; these observations resulted in research memos. Within the Producer Forum, there were 73 forums involving the 115 active members. Each forum could be as simple as one question

with one answer, or as complex as a discussion with 30 comments, lasting for months. Open forums could be read by any member, even inactive ones, but active group forums were restricted to sub-groups to protect the confidentiality of more sensitive data.

Figure DS2 shows an anonymized example of the two Excel files and one anonymized forum involving a supplier from Thailand, a supplier from the UK, and a RetailCo technical manager from the USA Hub.

FIGURE DS2
Sample of Excel Charts for Members and Forum data

(DS2a) Sample of Anonymized Demographic data

Data joined	Member	Position	Firm#	Country	Region	Position	Category	Tier	Supplies To
2012-10-03	M.P.059.001	Technical Manager	059	United Kingdom	1. United Kingdom	3. Supplier	2. Produce	1. Tier 1	R.G.163.078
2012-09-26	S.P.154.001	Sustainability Manager	154	Chile	4. America	3. Supplier	2. Produce	1. Tier 1	R.P.163.011
2013-07-11	R.P.163.001	Buying Manager - Chilled Salads	163	United Kingdom	1. United Kingdom	1. Retail	2. Produce	0. Tier 0	n/a
2012-08-20	S.P.019.001	Director	019	United Kingdom	1. United Kingdom	3. Supplier	2. Produce	1. Tier 1	R.P.163.087
2012-05-21	R.P.163.003	Category TM - European Hub	163	Spain	2. Europe Cont	1. Retail	2. Produce	0. Tier 0	n/a
2013-03-18	M.P.135.001	Managing Director	135	United Kingdom	1. United Kingdom	3. Supplier	2. Produce	1. Tier 1	R.P.163.026
2012-06-29	R.P.163.004	Sourcing Manager	163	United Kingdom	1. United Kingdom	1. Retail	2. Produce	0. Tier 0	n/a
2013-10-15	E.G.138.001	Director	138	United Kingdom	1. United Kingdom	2. Expert	1. General	1. Tier 1	R.G.163.078
2012-05-21	R.P.163.006	Technical Manager	163	South Africa	3. Africa	1. Retail	2. Produce	0. Tier 0	n/a
2012-09-12	M.P.169.001	Quality Manager	169	South Africa	3. Africa	3. Supplier	2. Produce	1. Tier 1	R.P.163.006
2012-11-21	P.P.166.001	Technical Manager	166	United Kingdom	1. United Kingdom	4. Producer	2. Produce	2. Tier 2	n/a
2014-04-02	E.G.025.001	Farm Manager	025	United Kingdom	1. United Kingdom	2. Expert	1. General	1. Tier 1	R.G.163.078

(DS2b) Sample of Anonymized Forum Data

Date posted	Member	Topic title	Post title	Post content	Forum code
2012-06-25	E.G.138.001	Rots in pears	Rots in pears	(...)	F.002
2012-06-28	M.P.059.001	Rots in pears	RE: Rots in pears	(...)	F.002
2013-07-01	M.P.135.001	Rots in pears	RE: Rots in pears	(...)	F.002
2012-07-23	M.P.169.001	Rots in pears	RE: Rots in pears	(...)	F.002
2012-07-23	R.P.163.001	Rots in pears	RE: Rots in pears	(...)	F.002
2013-03-18	R.P.163.003	Fruitlook: Affecting Water Use	Fruitlook: Affecting Water Use	(...)	F.008
2012-03-29	R.P.163.004	Fruitlook: Affecting Water Use	RE: Fruitlook: Affecting Water Use	(...)	F.008
2013-05-15	R.P.163.006	Fruitlook: Affecting Water Use	RE: Fruitlook: Affecting Water Use	(...)	F.008
2012-11-21	S.P.019.001	Cool Farm Tool	Cool Farm Tool	(...)	F.010
2014-11-22	S.P.154.001	Cool Farm Tool	RE: Cool Farm Tool	(...)	F.010

(DS2c) Exemplar of Anonymized Forum

F.022: "How to handle the sea shipment of mango better?"

S.P.157.001 Tier-1 Supplier, Thailand: Hi Everyone, Thai Mango has normal shelf life around 20-25 days when keep at temp 11c after harvesting at maturity 70-80%. If we want to do sea shipment to UK from Thailand, we need a shelf-life of total 35 days (transit time 25 days + local shelf-life after arrival 10 days). Does anyone have experience of extending life of Mango?"

M.P.182.001, Tier-1 Supplier, UK: "Please explain further so I can provide better assistance. Happy to assist."

R.P.163.086, RetailCo Hub, USA: "Hi, IfM.P.182.001 are willing to help certainly contact them - they have much experience in this area. I would think anyone that can successfully ship Thai

> mangos that distance will have a competitive advantage. My suggestion is to take a step back from shipping to make sure you have fruit grown with the correct pre- and post-harvest controls as black spot and break down are probably your biggest issues with a journey that long. For the shipment itself certainly ethylene scrubbers and the correct venting will be needed. I am not sure if anyone has done work on step down temperatures or MA technology for Mangos over that distance. For arrival that 10 days needs to include the customer shelf-life so you really want to be able to clear that volume in less than a week."(…)

Forum data was used in two ways. First, for quantitative purposes, it supported the matrices and diagrams of who interacts with whom. Taking the above forum F.022 as an example, the three participants in this discussion (coded as S.P.157.001, M.P.182.001, and R.P.163.086) have one 'knowledge exchange tie' between them as a result of their participation in this forum. Second, for qualitative purposes, it provided data for comparative analysis. The text content of the forum data was upload to NVivo software for qualitative, side-by-side analysis with interview data. Therefore, first-order codes emerged from both interviews and forum data.

The use of multiple data sources was key to building our case study. While interviews provided key informants' perceptions, Producer Forum data offered the ability to confirm these perceptions by comparing them to (a) quantifying knowledge exchange ties and participant profiles and (b) textual data showing exactly what type of knowledge was being shared. Additionally, the observation of webinars provided further insight into how participants were engaging in knowledge diffusion, which participants were more vocal, and how these live webinars complemented forum dynamics.

Understanding the Context

In the first phase, we established the context of the initiative, the strategic goals of RetailCo – as Sourcing Director quote and a researcher memo illustrate:

"We looked at major trends and changes that were happening in the wider environment. One of them is the macro change of food supply and demand in the world and the second one is about the increasing importance

and growth of social networking. [Therefore] the strategy was about how we can bring all staff across the world into a social network. Then it occurred to me that we should be doing the same thing with our producers: bringing them into a social network and using that network to help us to address the macro challenges of supply continuity, better end-to-end communication, and how to improve productivity and reduce waste across the supply network" (G01)

"The goal of the Producer Forum seems to diffusing best practices that had been happening in a local, face-to-face environment to foster supplier-supplier collaboration in a dispersed, global supply network context. For example, before the Producer Forum, the Dairy product category already had a supplier working group in the UK discussing best practices. Now, with the Producer Forum, such working groups can involve suppliers from multiple countries allowing them to exchange knowledge through the online platform." (Researcher Memo)

This phase consisted of initial first-order codes that reflect participants' words and identify key elements that help identify the drivers of and barriers to knowledge diffusion [See Table DS1 for the final list].

As a key outcome of this phase, we identified *product category* as a key variable for understanding the dynamics of the Producer Forum. We saw that both RetailCo's buyers [commercial focus] and technical managers [CSR/sustainability focus] were organized according to product categories. Therefore, their face-to-face efforts regarding supplier-supplier collaboration had always been within specific product categories [or even sub-categories]. They have been organized in such way because of the specificities of each product category in terms of technology for farming, post harvesting, warehousing and transportation requirements, and so forth. Discussions such as pesticides, legislation, innovation, sustainability, are product-category-specific. This is not to say that there are some common topics that can bring together different product categories, such as working conditions, but they seemed to attract less attention from suppliers. Therefore, the goal of the Producer Forum was to reproduced this category-specific logic in the online environment, as showed below:

"Our goal is to tailor the content [for each product category] such as produce, lamb, fish, poultry and pork. And to organize webinars from experts or from themselves [technical managers] about the key challenges in the industry at the moment" (PF Manager)

"The Producer Forum needs to be clearly split down into dairy, produce, etc, as producers don't want to see issues about other product categories. You know, why would they? They would want to just go directly to their interests" (PF Champion).

The analysis of forum data confirmed the importance of category-specific discussions: the majority of questions and answers were very technical in nature (see above the example in Figure DS2), thus category-specific discussions restricted those involved to be in the same type of practice. For example, discussions of new technologies, adaptations to new regulations, and pesticides all triggered participation of suppliers sharing the same practices.

Therefore, recognizing product category as a proxy for *practice* showed us where to focus on the next phase. At the conclusion of Phase 1, we asked the following questions: Could product category be used as a proxy for practice? Could the Producer Forum reproduce face-to-face supplier-supplier collaboration at a global scale? What was the perspective of non-heavy users? What was the perspective of suppliers? To answer these questions, our research expanded in Phase 2 to include the perspectives of buyers [commercially oriented and different from Technical managers], sourcing hubs [outside the UK], and suppliers.

PHASE 2: REFINING FIRST-ORDER CODES (Year 1, Month 8-12)

Data Collection

At the start of Phase 2, we approved an additional wave of 15 interviews, and access to demographic and forum data for another 12 months. Like in Phase 1, we conducted UK-based interviews in face-to-face meetings (9 interviews), and we conducted all other interviews via Skype (6 interviews), and we followed the same procedures for data validation and research quality.

This phase enabled us to confirm or reject initial impressions and reach the final version of first-order codes assuring that codes were: (i) mutually exclusive, (ii) complementary, and (3) representing behaviour/action that could drive, hinder, or moderate the process of knowledge diffusion. In summary, data in this second phase derived from:

- Second wave of interviews (15):
    - 1 Technical director (T04)
    - 3 Commercial directors (C01-03)
    - 5 Technical managers (T10-14)
    - 2 Buyers (C04-05)
    - 4 Suppliers (S01-04)
- Producer Forum posts(additional six months of demographic and written data)
- Further observation of live webinars as a silent observer
- Validation workshop in Month 10 with PF management team (T02, T03, and T04)

Handling Discrepancies

For the Phase 2 interviews, the focus shifted to an in-depth understanding of specific initiatives within the Producer Forum to capture perspectives other than those of the technical team. This time, we used theoretical sampling to include the RetailCo's commercial side. Specifically, we included three commercial directors, two buyers and four suppliers, all of which could raise barriers to the technical managers' focus on sustainability given the tensions related to price reductions.

As a result of this strategy, we were able to identify discrepancies in data collected from these different sources. Specifically, we found the commercial and technical teams had conflicting perspectives. For instance, the commercial team was generally less confident about the potential of the Producer Forum, when compared to the technical team. This difference in views might be due to their different functional focus. In general, technical managers are more focused on sustainability/CSR, which should drive their involvement with the Producer Forum, while the commercial team was more focused on cost reductions and

deliveries, which is not an objective of the Producer Forum. The discrepancy between views of the commercial and technical teams allows us to better understand both drivers and barriers to the initiative. Most importantly, we discovered that one commercial buyer was very involved with the Producer Forum, and had managed to coordinate the most popular forum related with apple packing. Therefore, the data in the Producer Forum allowed us to see that discrepancies did not necessarily result from a department, but could also derive from personal views. This understanding of discrepancies allows us to see that drivers and barriers of the initiatives could co-exist.

Triangulating Data Sources

We refined first-order codes by triangulating the qualitative data [interview data and forum data imported to NVivo], the quantitative data [quantification of forum data], and the validation workshop data. Our quantitative analysis of forum data showed a high concentration of knowledge diffusion within product categories [76.4% in Year 1]. In addition, it showed the opposite result for geographic dispersion [39.4% in Year 1]. Contrasting qualitative and quantitative data, geographic dispersion emerged as both an opportunity and a barrier to knowledge diffusion. We kept two angles - the negative angle of *"suppliers protecting their competitive advantage"* and the positive angle of *"suppliers perceiving peers from distant geographic regions as non-competitors"* as separate codes to acknowledge the tension between the competition and cooperation, but to avoid collapsing similar codes or discarding one in favour of the other too early in the process. Illustrative interview quotes:

> Suppliers protecting their competitive advantage: "Some producers just are not willing to share best practices because they feel this would hurt their competitive advantage" (Expert)
>
> Suppliers perceiving peers from distant geographic regions as non-competitors: "Spanish citrus growers grow at a completely different time to South African citrus, so there is a relationship that we can build

between them, where they can share learning. They tend to do that themselves, anyway. So it is already happening." (Technical Manager 5)

We also refined the first-order codes through the first validation workshop, which was held at RetailCo's headquarters with the Producer Forum's management team. The workshop consisted of a two-hour meeting that began with the lead researcher giving a 30-minute presentation, followed by a group discussion of the Producer Forum. The presentation included first-order codes and SNA results [which were preliminary at this stage]. The discussions provided additional insight into the case study. Researcher memos helped registering the workshop.

The validation workshop confirmed our understanding (based on the qualitative coding) that the management team was focused on tailoring the Producer Forum to allow drive activities for specific product categories. It also confirmed our understanding that the Producer Forum could act as an amplifier of former activities that were previously restricted to face-to-face events. In other words, through a series of support videos and webinars, the Producer Forum was broadcasting practices from high performing producers to a global audience of peers, helping globally dispersed producers of the same product category learn from each other (through videos) and engage with one another (during webinars).

PHASE 3: ABSTRACTING TO SECOND-ORDER CODES (Year 2)

Data Collection

In Phase 3, we reached 24 months of forum data, which supported the analysis of Year 1 versus Year 2 in terms of how the knowledge exchange network evolved. Additionally, we triangulated our findings with two validation workshops to develop the final version of second-order codes. In summary, the data we collected in this third phase derived from:

- Producer Forum (Additional six months of demographic and forum data for a final total of 24 months of data)

- Further observation of live webinars as a silent observer
- Two validation workshops with PF management team (T02, T03, and T04), held in the same format as the first one to discuss final SNA results and second-order codes

Supplement to Social Network Analysis (SNA)

We conducted our final SNA analysis on 24 months of Producer Forum data [both demographic data and forum data]. At this stage, the Producer Forum accounted for 2,779 members, 275 of whom were active members engaging in 255 forums. Through SNA diagrams, we were able to observe a deviation in the Producer Forum from the initial commercial supply network. In other words, we found there had been significant knowledge diffusion activities across participants with no previous commercial relationship, such as competing suppliers from different countries, unrelated suppliers from different tiers, and suppliers and experts. Results are provided in Figure 3 and Table 4 in the main manuscript.

The SNA conducted in this study consisted of visually mapping the network layers and running regression tests using the quadratic assignment procedure (QAP) regression, which is a nonparametric, permutation-based test that preserves the integrity of the observed structures [i.e., it explicitly retains the interdependency among the dyads] (Krackhardt, 1987). We selected QAP regression because it is superior to OLS in multiple regression models based on dyadic data since it maintains the dyadic element in the analysis (Krackhardt, 1988) and is dependent on data of the whole network (Løvås & Sorenson, 2008) [In this case study, the access to the whole network participating in the online platform allowed for a QAP regression]. The QAP regression in this study follows previous studies (see: Doreian & Conti, 2012) but expands to an inter-organizational context. SCM studies using this method are scarce due to data constraints.

To run the QAP regression, we represented each network layer by a squared matrix (Cross et al., 2001) with all active network members; in this case, 275 x 275 matrices (active members) were produced. We applied QAP regression tests to all dyads formed by the

equivalent cells in the matrices (independent matrix [im_{ij}]→ dependent matrix [dm_{ij}]), as represented in the Figure DS3 below [note: QAP ignores the diagonal of the matrix]:

FIGURE DS3

Visual Representation of QAP Regression

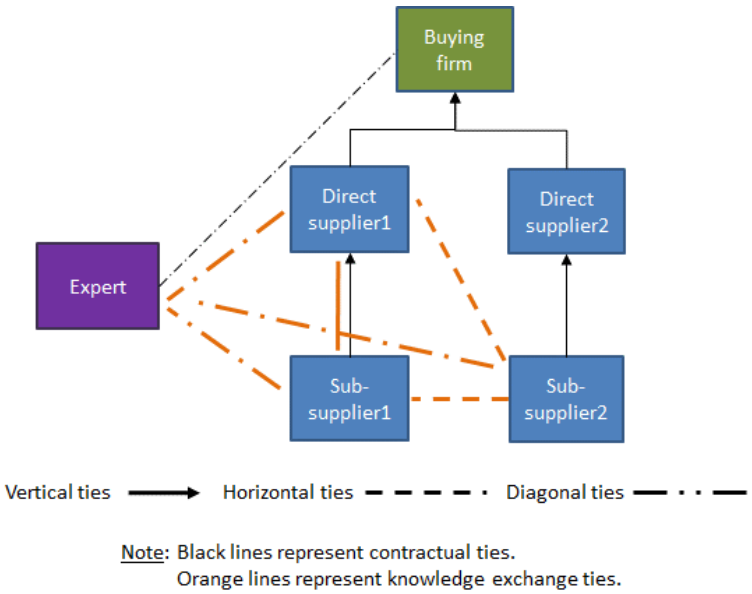
(3a) Contractual layer (Independent matrix)

	A	B	C	D	E	F
A		1	1	0	0	1
B	1		0	1	0	0
C	1	0		0	1	0
D	0	1	0		0	0
E	0	0	1	0		0
F	1	0	0	0	0	

(3b) Knowledge-exchange layer (Dependent matrix)

	A	B	C	D	E	F
A		0	0	0	0	0
B	0		0	1	1	1
C	0	0		0	0	0
D	0	1	0		1	1
E	0	1	0	1		1
F	0	1	0	1	1	

(3c) Visual diagram of both layers juxtaposed



Note: Black lines represent contractual ties.
Orange lines represent knowledge exchange ties.

QAP regression is similar to a normal regression, but it uses matrices [instead of columns] as inputs. In this research, QAP regression was based on three independent matrices [Boolean cells]: (i) practice homophily [product category], (ii) geographic homophily [co-location], and (iii) relational homophily [commercial ties]. In this regression, each dyad [e.g., Member A - Member B] is represented by the value 1 if the members share the same attribute [respectively same practice, same location, or commercial contract] and the value O otherwise. These three independent matrices are regressed against one dependent matrix

representing knowledge ties. In the knowledge ties matrix, the cells have a value determined by the total number of interactions for each dyad during the 24-month period. Using valued cells in the knowledge ties matrix is key for distinguishing between a dyad of members who have engaged only once from another dyad of members who have engaged multiple times. Figure DS4 shows *partial* exemplary matrices:

FIGURE DS4

Partial Exemplary Matrices (25 by 25 members each)

Product category matrix	S.P.154.001	S.P.019.001	R.P.163.003	R.P.163.006	M.P.169.001	P.P.166.001	R.G.163.009	P.P.128.001	S.P.053.001	P.P.106.001	R.P.163.011	M.P.119.001	M.P.073.001	P.P.136.001	E.P.110.001	S.P.186.001	R.P.163.016	E.G.001.001	R.P.163.019	R.P.163.022	R.G.163.024	R.M.163.025	M.P.023.001	S.P.046.001	P.P.033.001
S.P.154.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
S.P.019.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
R.P.163.003	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
R.P.163.006	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
M.P.169.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
P.P.166.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
R.G.163.009	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
P.P.128.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
S.P.053.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
P.P.106.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
R.P.163.011	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
M.P.119.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
M.P.073.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
P.P.136.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
E.P.110.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
S.P.186.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
R.P.163.016	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
E.G.001.001	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
R.P.163.019	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
R.P.163.022	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
R.G.163.024	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
R.M.163.025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
M.P.023.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
S.P.046.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
P.P.033.001	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1

Geography matrix	S.P.154.001	S.P.019.001	R.P.163.003	R.P.163.006	M.P.169.001	P.P.166.001	R.G.163.009	P.P.128.001	S.P.053.001	P.P.106.001	R.P.163.011	M.P.119.001	M.P.073.001	P.P.136.001	E.P.110.001	S.P.186.001	R.P.163.016	E.G.001.001	R.P.163.019	R.P.163.022	R.G.163.024	R.M.163.025	M.P.023.001	S.P.046.001	P.P.033.001
S.P.154.001	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
S.P.019.001	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
R.P.163.003	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
R.P.163.006	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
M.P.169.001	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
P.P.166.001	0	1	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
R.G.163.009	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
P.P.128.001	0	1	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
S.P.053.001	0	1	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
P.P.106.001	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
R.P.163.011	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M.P.119.001	0	1	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
M.P.073.001	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
P.P.136.001	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E.P.110.001	0	1	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	0	0	1	1	1
S.P.186.001	0	1	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	0	0	1	1	1
R.P.163.016	0	1	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	0	0	1	1	1
E.G.001.001	0	1	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	0	0	1	1	1
R.P.163.019	0	1	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	0	0	1	1	1
R.P.163.022	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
R.G.163.024	0	1	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
R.M.163.025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
M.P.023.001	0	1	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1
S.P.046.001	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
P.P.033.001	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Commercial layer matrix	S.P.154.001	S.P.019.001	R.P.163.003	R.P.163.006	M.P.169.001	P.P.166.001	R.G.163.009	P.P.128.001	S.P.053.001	P.P.106.001	R.P.163.011	M.P.119.001	M.P.073.001	P.P.136.001	E.P.110.001	S.P.186.001	R.P.163.016	E.G.001.001	R.P.163.019	R.P.163.022	R.G.163.024	R.M.163.025	M.P.023.001	S.P.046.001	P.P.033.001
S.P.154.001	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S.P.019.001	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R.P.163.003	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	1	1	0	0	0	0
R.P.163.006	0	0	1	1	1	0	1	0	0	0	1	0	0	0	0	0	1	0	1	1	1	1	0	0	0
M.P.169.001	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P.P.166.001	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R.G.163.009	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	1	1	0	0	0	0
P.P.128.001	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S.P.053.001	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P.P.106.001	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R.P.163.011	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	1	1	0	0	0	0
M.P.119.001	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
M.P.073.001	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
P.P.136.001	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
E.P.110.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
S.P.186.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
R.P.163.016	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	1	1	0	0	0	0
E.G.001.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
R.P.163.019	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	1	1	0	0	0	0
R.P.163.022	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	1	1	0	0	0	0
R.G.163.024	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	1	1	0	0	0	0
R.M.163.025	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	1	1	1	0	0	0
M.P.023.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S.P.046.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
P.P.033.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Knowledge exchange layer matrix	S.P.154.001	S.P.019.001	R.P.163.003	R.P.163.006	M.P.169.001	P.P.166.001	R.G.163.009	P.P.128.001	S.P.053.001	P.P.106.001	R.P.163.011	M.P.119.001	M.P.073.001	P.P.136.001	E.P.110.001	S.P.186.001	R.P.163.016	E.G.001.001	R.P.163.019	R.P.163.022	R.G.163.024	R.M.163.025	M.P.023.001	S.P.046.001	P.P.033.001
S.P.154.001	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
S.P.019.001	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
R.P.163.003	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
R.P.163.006	0	0	0	18	0	2	0	1	0	1	0	0	0	0	0	0	0	3	0	0	0	0	1	0	4
M.P.169.001	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P.P.166.001	0	0	1	2	0	6	0	0	1	1	1	1	0	0	0	1	0	2	0	0	0	0	0	0	0
R.G.163.009	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
P.P.128.001	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S.P.053.001	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P.P.106.001	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R.P.163.011	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M.P.119.001	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0
M.P.073.001	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0
P.P.136.001	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
E.P.110.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
S.P.186.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
R.P.163.016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
E.G.001.001	1	1	1	3	0	2	1	0	0	0	1	1	2	1	0	0	0	43	0	1	0	0	0	0	0
R.P.163.019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
R.P.163.022	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
R.G.163.024	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
R.M.163.025	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
M.P.023.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
S.P.046.001	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
P.P.033.001	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4

To analyse these matrices, we calculated descriptive percentages for the overlap between each independent matrix and the dependent matrix. Then, we conducted QAP regression. Table 4 in the manuscript shows both descriptive statistics of the overlap in percentage and the results of the QAP regression for Year 1 and Year 2 in order to capture the trend/shift over time. When interpreting the results, we took the density of the matrices into account. In this study, the knowledge exchange matrix was highly sparse [knowledge exchanges

represented 2.5% of possible connections], which means that most members did not interact with each other, thus we expected the R^2 results to be low (Borgatti et al., 2002). This must be taken into consideration when using QAP regression in sparse supply networks.

Supplement to Second-order Codes

The goal of Phase 3 was to move from first-order codes to second-order codes through a dialogue between theory and data (Ketokivi & Choi, 2014). Moving from first-order to second-order codes permitted the triangulation of different theoretical lenses in the search of a better data-theory fit (Gioia et al., 2012). As noted, this study's data included interviews, forum text data, and research memos from observations and validation workshops. For theory, we explored Social Network Theory more broadly, and we considered the Network of Practice (NoP) view more specifically (Brown & Duguid, 2001), which we discuss in the Manuscript's literature section.

Table DS1 provides supporting data to the Data Analysis Structure presented in the Manuscript's Figure 2, following Pratt and colleagues (2006) and Pratt (2008):

TABLE DS1

Support to Data Structure

Exemplary data (interviews, forum data, memos)→	1st Order Coding→	2nd Order Coding
"It is better when we split [activities] in main product categories, such as produce and dairy. (...) More segmentation by product category help to engage suppliers." (Tier-1 Supplier, South Africa)	(+) Suppliers valuing category-specific activities [f q v o]	Practice homophily *Data sources: 45* *Quotes: 98*
Interview quote: *"There are all sorts of hidden stories about successful farmers, producers, who work with RetailCo indirectly for many, many years and have not really the chance to expose their experience and vice-versa. But who could add much more value in terms of what are their realities? And we often talk about farm to fork, and this is real, you know? The network is the real connection between the farm and the fork, because the two can no longer be detached."* (Sourcing Diretor 1) Forum data: "*Please see the attached video that details the reasons for bruising in apples, from one of our top producers, [to foster the discussion] on which preselected methods we can use based on risk analysis"*(R.P.163.006, South African Hub in Forum 098)	(+) Producer Forum amplifying face-to-face practice improvement activities [v]	

Exemplary data (interviews, forum data, memos)→	1st Order Coding→	2nd Order Coding
"There is a genuine confidentiality question that needs to be answered, but I think there are parallels [alternative views] with people who raise that question and people who are generally negative anyway, because I think people who are extremely positive about the future of their businesses are always people who think: 'my business will be successful if I am always thinking faster and moving quicker I will be one step ahead of the competition'" (PF Champion)	(-) Suppliers resisting due to lack of confidence in their performance [v]	Fear of coopetition *Data sources: 14* *Quotes: 33*
"Some producers just are not willing to share best practices because they feel this would hurt their competitive advantage. It's a very competitive market; hence our biggest challenge is getting producers to understand and wrap their heads around using the network and how it affects what they think is their competitive advantage" (Expert, UK)	(-) Suppliers protecting their competitive advantage [v]	
"Producers do not necessarily want another producer to know what their problem is, what problems they are having in terms of food safety, in terms of sustainability or anything else. So they are hesitant to put their question out there for everyone. I think they need to step back and realize that it is a tool to get answers. And if we are facing it or if someone else is facing it then probably more people are as well. But I think there is a fear in the industry, because it is competitive, to actually put your problems out there" (Tier-1 Supplier, USA)	(-) Suppliers unfamiliar with working with competitors [v o]	
"Direct suppliers are concerned about the transition and that the firm [RetailCo] will start buying directly from these farms instead of using them as the broker and as the intermediary" (PF Manager)	(-) Direct suppliers fearing elimination by the buying firm [v]	Fear of disintermediation *Data sources: 9* *Quotes: 20*
"There is hesitation from the direct suppliers [to invite their producers] because it gives us [RetailCo] a direct link to their producers" (Technical Manager 5) *"The middlemen [direct suppliers] select growers [sub-suppliers] they have the best relationship with, so we only see part of the supply chain. (...) It is all via the middlemen [direct suppliers]"* (Technical Manager 12)	(-) Direct suppliers hesitating to encourage sub-supplier participation [v]	
"Communication is a major challenge when you go down the supply chain, making sure that everyone gets the same information" (PF Manager) *"There are all sorts of hidden stories about successful farmers, producers, who work with RetailCo indirectly for many, many years and have not really the chance to expose their experience and vice-versa. But who could add much more value in terms of what are their realities? And we often talk about farm to fork, and this is real, you know? The network is the real connection between the farm and the fork, because the two can no longer be detached."* (Sourcing Director 1)	(+) Buying firm fostering transparency in the network [v]	Procedural justice (Vertical axis) *Data sources: 12* *Quotes: 30*
"This is about the neutrality and credibility of the Producer Forum. This is for the producers, not for RetailCo. So this is a key challenge. If we [RetailCo] direct it, it will not work and therefore we need it to be self-directed [by suppliers]" (Technical	(+) Buying firm maintaining a steering committee [v]	

Exemplary data (interviews, forum data, memos)→	1st Order Coding→	2nd Order Coding
Director) *"We set up a Producer Advisory Board that works as a steering committee so that the Producer Forum gets much better guidance and direction from the producers in the network."* (PF Manager) *"Governance and engagement are key. (...) So it is really about keeping all the key stakeholders [suppliers and experts] aligned for the Producer Forum to get steered by them in the right direction."* (Technical Director)		
"We ask them [suppliers] to upload their performance so we can give them 'a league table of results'. And we then confidentially come back to them and compare their performance with benchmarking references." (Sourcing Director 3)	(+) Buying firm ensuring data confidentiality[v o]	
"We do not want to breach any competition issues and have people discussing prices. (...) The discussions must be around non-competitive issues and industry-wide issues. (...) The solutions are often based on investments." (Technical Manager 8, USA) *"[The focus in on] non-competitive information that they [suppliers]can learn from, which is around one common interest, like energy consumption and water usage, which they can access information and expertise that is from around the world but is outside their own narrow network."* (PF Champion)	(+) Buying firm restricting type of performance disclosed [v o]	
"Spanish citrus growers grow at a completely different time to South African citrus, so there is a relationship that we can build between them, where they can share learning. They tend to do that themselves, anyway. So it is already happening." (Technical Manager 5) Forum data extract of potential collaboration Portugal and UK: *"We grow brassicas in Portugal and the level of dithio-carbonates found in the residue tests this year is all over the place, no chemicals were applied to the crop. I have spoken to our lab and found some information on the internet about false positives. Is there anything we can do to eliminate these false positives? Does is happen in other countries? Would be great to get some feedback on this topic."* (P.P.052.002, Tier-2 Supplier, Portugal) *"Hi, I do not think it is possible to test for dithio-carbamates in brassicas as the naturally occurring sulphur containing phyto-chemicals breakdown under analysis to carbon disulphide which is the same compound that is measured to test. Regards,"* (P.P.009.001, Tier-2 Supplier, UK)	(+) Suppliers perceiving peers from distant geographic regions as non-competitors [f v]	Supplier geographic dispersion (Horizontal axis) *Data sources: 29* *Quotes: 72*
Interview quotes: *"Suppliers benefit from non-competitive knowledge that they can learn from when such knowledge is around one common interest, like energy consumption and water usage, which they can access information and expertise that is from all around the world"* (PF Champion) *"A lot of our suppliers are excited about the network because we can introduce them to people who do the same thing non-*	(+) Suppliers exploring complementarity across geographies [f q v]	

Exemplary data (interviews, forum data, memos)→	1st Order Coding→	2nd Order Coding
competitively in other regions and they can learn from each other." (Technical Director) Forum data extract of UK and Zimbabwe collaboration: *"Hello all, I was wondering if anybody could please highlight to me or point me in the right directions as to where I can find any ETI guidelines or any regulations surrounding employees working in cold rooms, such as: (1) How long are employees meant to work in certain temperatures?; (2) How often should they have breaks while working in certain temperatures?; (3) The correct PPE that must be provided? Any info would be much appreciated, thanks."* (P.P.136.001, Tier-2 Supplier, Zimbabwe) *"Hi, have you had a look through the HSE guidelines in the following document attached? Regards,"* (S.P.074.002, Tier-1 Supplier, UK) *"Thanks for this Richard this is helpful"* (P.P.136.001, Tier-2 Supplier, Zimbabwe) Forum data extract of UK and China collaboration: *"How to extend the shelf life of red globe in cold storage? We are now re focusing on how to prolong the shelf life of red globe after harvest time, because we want to extend the shelf-life by keeping in cold storage for 2-3 months, have any special way or treatment when goods in cold room which can keep it's fresh?"* (S.P.148.001, Tier-1 Supplier, China) *"Hi, in addition to liner/pad combinations highlighted by X, there is also some new technology, a solution which combines the SO2 pad and the liner into one solution called 'XYZ'. Please see the link below (...). The benefits are highlighted on the link above, but they help (...) Hope this helps"* (M.P.119.001, Tier-1 Supplier, UK)		
"Through RetailCo's global reach, [we can] access experts who can help producers. So if you are a small producer in South Africa, for example, you might not know who is the best post-harvest expert on your product category, but we can know who he is, for example, in Chile" (Technical Director)	(+) Buying firm inviting experts to the Producer Forum [v]	Nexus organizations (Diagonal axis) *Data sources: 30* *Quotes: 62*
Interview quote: *"The expert seminar was very successful because it related directly to what we are producing. (...) So yes, that was a big success"* (Technical Manager 7) Forum extract of expert leading discussion: *"I am tailoring the dialogue with particulars relevant for you so please reply me on the following: (1) Which crops/varieties present the most postharvest challenges to you? (2) What current challenges are you facing regarding in preserving quality for extended shelf life?"* (E.P.039.001, Expert, UK) *"In response to your request above: (1) Our product is ABC, (2) the problems we encounter in long-term store are the following: Spread of rots in store (e.g. Mucor), Spread of storage scab. Your insight / experience / findings of the above would be of much interest."* (P.P.166.001, Tier-1 Supplier, UK)	(+) Participants learning from experts [f o]	

Exemplary data (interviews, forum data, memos)→	1st Order Coding→	2nd Order Coding
"For Table Grapes, I would particularly like to understand if possible the impact on shelf life of the time between the moment the product is harvested in the field and when it arrives in cold chambers. Are there any data about this somewhere available? What is the best way to measure it (tools, protocol). Thanks," (R.P.163.011, Retail, Chile) *"One of our main issues is translucent waste in the packed product on citrus at the start of the season when the product has to be degreed. I was involved in some of your early work on browning of the cut ends on celery. I would like an update on this work if you can share it at this stage. Best regards,"* (R.P.163.003, Retail, Spain)		
"We have a key target, which is to set up twelve action groups over the next year; and we already have a few. We are running one on carbon foot printing, so that group is already established. The food waste one which I mentioned before hopefully will work well. Then we have one on renewable energy to be launched soon." (PF Manager) *"Action groups are hosted in a specific area of the Producer Forum. It follows some sort of 'by invitation only' that controls access. Some action groups involve disclosure of monthly data and RetailCo is clearly cautions about supplier performance confidentiality."* (Researcher Memo)	Knowledge diffusion with ***low*** breadth (reach) of participation [v o]	Action groups *Data sources: 52* *Quotes: 84*
"The decision to quick-off the action group with a pilot project with first adopters has led to the development of a business case that is helping to show other producers the benefits of involvement in the carbon foot printing action group. Live testimonials of first adopters seem very positive to other producers. In addition, live questions from producers clarify implementation issues and help them moving forward. This seems the most successful action group so far." (Research Memo)	Knowledge diffusion with ***high*** depth (tacitness) of knowledge [v o]	
"A few broadcasting forums include recordings of site visits to some producers that have implemented best practices. These videos will remain available for any participant of the Producer Forum to watch at any time." (Research Memo) Forum extract of video with best practice: *"Following on the post about the Solid Rain, you can now watch a video (in Spanish but with English subtitles), available here on this link. Find out more about the technology and how it could potentially be used on a larger scale to reduce irrigation. If you have any questions or want to know more about it, please reply to this post."* (Expert, UK)	Knowledge diffusion with ***high*** breadth of participation [f v]	Broadcasting forums *Data sources: 50* *Quotes: 58*
"Despite the breadth of broadcasting forums, most receive limited responses. Therefore, when compared to action groups, the depth of knowledge content is limited." (Research Memo)	Knowledge diffusion with ***low*** depth of knowledge (tacitness) [f v]	

Notes: For the first-order codes, all codes derived from the interviews. We show in superscript when data coding was supplemented by "q" QAP regression; "f" forum data; "v" validation workshops; and "o" online observation. In

addition, first-order codes show (+) or (-) to indicate the positive or negative impact to knowledge diffusion. For the second-order codes, we show the total number of sources and quotes of all their first-order codes combined.

At the end of the third phase, second-order codes were mature, which allowed us to abstract the relationships between them and thereby develop our propositions in Phase 4.

PHASE 4: DEVELOPING PROPOSITIONS (Year 3)

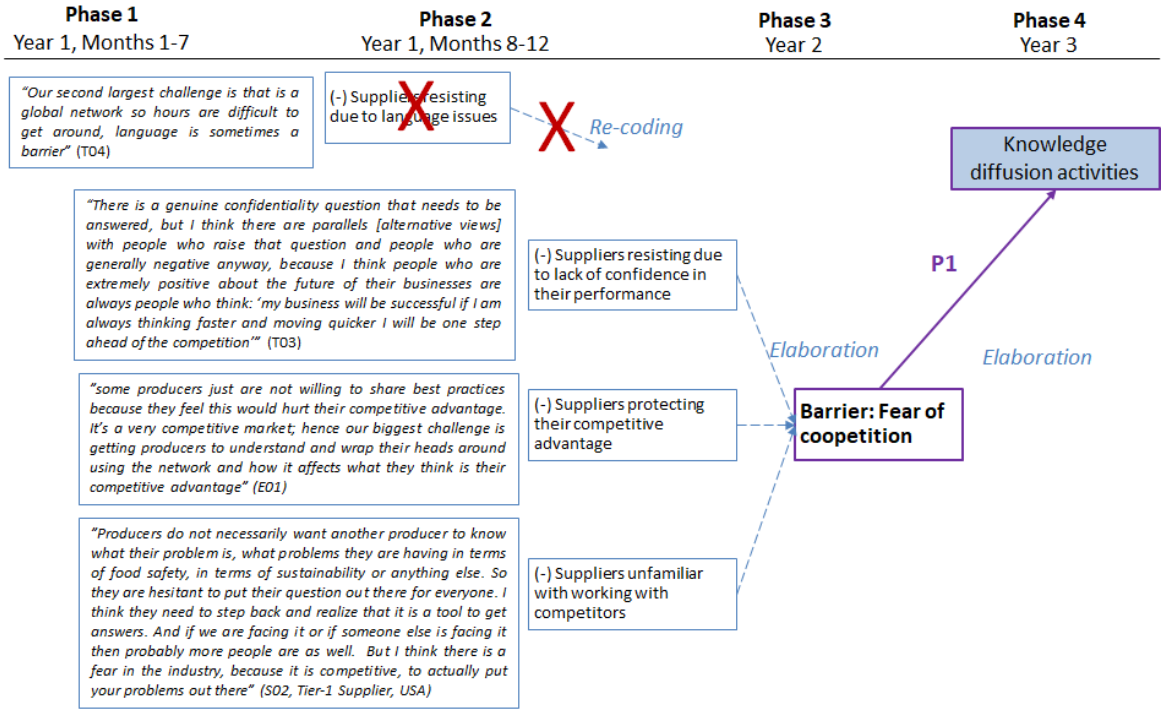
The final phase [Phase 4] focused on theory elaboration, the development of the propositions, and the interactions between the propositions. In this final phase, we built our theoretical model.

Supplement to Development of Propositions

Figure DS5 shows our development process of Proposition 2a as an exemplar of the rationale behind the evolution from isolated second-order codes to theoretical propositions.

FIGURE DS5

Rationale for Development of Proposition 2a



Supplement to Interaction between Propositions

In this phase, we also articulated the interactions between barriers and moderators, resolving clashes and conflicts between issues, such as the dual nature of geographic dispersion, in order to make sure our propositions could be combined into a single theoretical framework. To articulate these interactions, we asked ourselves:

– *"If knowledge so far has been shared locally, can the Producer Forum amply it at a global scale?"*

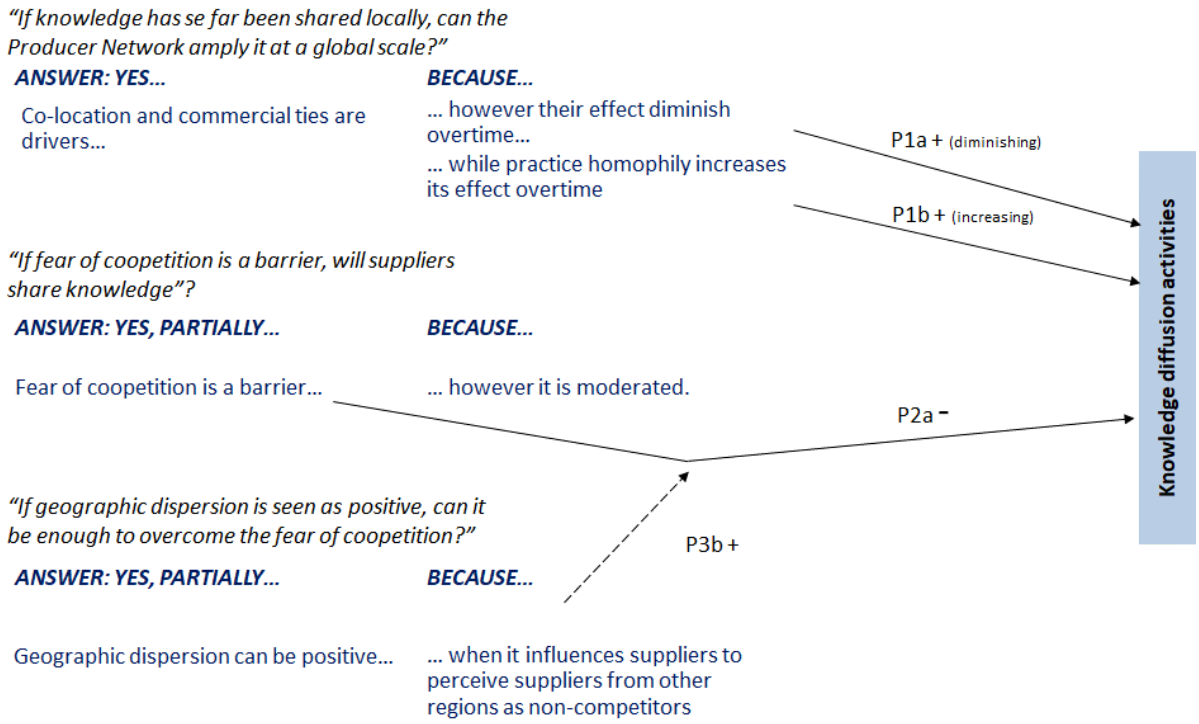
– *"If fear of coopetition is a barrier, will suppliers share knowledge?"*

– *"If geographic dispersion is seen as positive, can it be enough to overcome the fear of coopetition?"*

Through iteration, we determined whether and how data could simultaneously answer the above questions. The answers to these questions revealed the moderating effects of and inter-connections between propositions. Figure DS6 below outlines the rationale we used to reconcile the answers to these questions and the process we used to develop our final conceptual model of a global supply NoP [pictured in Manuscript's Figure 4].

FIGURE DS6

Rationale for Elaboration of Propositions1a, 1b, 2a and 3b



As seen in Figure DS6, our process exposes the duality of geographic dispersion and shows how it unfolds overtime. At first, low geographic dispersion [i.e. co-location is a driver of knowledge diffusion because people base their behaviour on previous experiences in face-to-face interactions. However, the effect of co-location diminishes overtime and is replaced by an increasing importance of practice homophily. Then, geographic dispersion becomes a driver of knowledge diffusion when geographic dispersion diminishes suppliers' perception of competition. As such, geographic dispersion has a moderating effect on supplier-supplier interactions. In this particular example above we reconcile relationships between P1a, P1b, P2a and P3b. We followed the same process when we developed the other propositions, resulting in the final conceptual model pictured in Manuscript's Figure 4.

This Data Supplement intends to offer transparency to this research project, but also support replicability for future studies in SCM using the network level of analysis.

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