Managing Extended Supply Chains


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ABSTRACT

We address how to manage extended supply chains that lie beyond the first-tier suppliers. The first-tier suppliers have their suppliers who provide them with goods or services. While lower-tier suppliers are often not an explicit concern of the focal firm, the firm’s performance not only depends on the performance of its first-tier suppliers, but on the performance of their suppliers and beyond. These lower-tier suppliers are much less visible and may not even be known to the focal firm. Our intention is to bring awareness to the importance of these lower-tier suppliers and capture possible strategies that buying companies may pursue to manage them. Extended supply chains are complex and involve evolving relationships between various buyers and suppliers that are located along different tiers of the chain and across different parts of the globe. We address several topic areas and suggest emerging research focuses that should be considered in coming years.

The sun has gone down in the western sky. As the darkness descends, you decide to go for a walk. Street lamps have come on and the air is cool. As you are walking, you run into an old man crouched down on the ground under a street lamp. He is looking for something. You ask, “Sir, may I help you find something?” He replies, “Yes, I dropped my key and I do not seem to be able to find it.” You graciously crouch down next to him under the street lamp to help him look for it. After a while, you ask, “Sir, could you be more specific as to where you dropped the key?” The old man replies, “I dropped it over there, around the corner in that dark alley.” A bit flustered, you reply, “Sir, shouldn’t you be looking over there where you dropped the key?” The old man coolly replies, “Ah, but this is where the light is.”

Too often, we are like this old man, looking for a solution where the light is. Too often, both researchers and procurement managers are like this old man, looking for solutions to their problems within their immediate visual range. They can see their first-tier suppliers, so that is where they go. They look for their keys there. Once an executive from Toyota came to visit Phoenix and he seemed a bit agitated. Toyota had been having a quality problem with one of their major suppliers, and they had subsequently invested a lot of time and effort to help the
supplier address the problem. In the end, they discovered the source of the quality problem was coming from a second-tier supplier located in Phoenix. This second-tier supplier had been outside their visual range until then. They were now in the realm of managing extended supply chains.

The three papers published in this special topic forum address the realm of extended supply chains. Nath, Eweje and Bathurst (2021) investigate the institutional effects of sustainable practices across the multiple tiers of supply chains. Li, Alam, Bernardes, Giannoccaro, Skilton and Rahman (2021) address the ripple effect of financial squeezing across the multiple tiers of supply chain. Wiedmer and Griffis (2021) study topological characteristics of extended supply networks.

In this introductory paper, we introduce a number of topics that shed the light on issues and solutions related to extended supply chains. These forward-looking topics go beyond the ones specifically considered in these three papers. Table 1 offers an overview of the topics. Each topic listed in the table is shown in italics in the text.

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**Coordination, planning and control challenges**

Supply chains are about getting the right product to the right place at the right time. Key attributes in that process are coordination, planning and control. As supply chains become more dispersed, firms need to carefully orchestrate the different elements of coordination, planning and control not only within their organizations, but also across the visible portion of their supply chains (Carter, Rogers, and Choi, 2015; Kembro, Naslund, and Olhager, 2017). Such orchestration calls for building systems that promote higher levels of *transparency* across the
supply chain. Specifically, the increasing demand for transparency has required firms to seek to
develop visibility into the far reaches of the supply chain to understand sources of disruption to
build redundancy and resiliency into these supply chains. Apple, for instance, has decided to
control just about all parts that go into their product and has good visibility into their supply
chains (Apple Inc., 2012). Honda, because their product has a lot more parts compared to those
produced by Apple, has only selective visibility across their supply chains (Choi and Hong, 2002;
Giannoccaro, Nair, and Choi, 2018).

Increased transparency is also necessary to better respond to consumer and societal awareness
and changing preferences, especially given that the dwindling natural resources of the planet
impose new constraints and pressures on managers to design resource optimized supply chains
that continue to serve customers in a focused manner (Heal and Park, 2016; Slay and Dooley,
2020). In supply chain management (SCM), we face twin challenges—on the downstream side,
firms need to be consumer facing to manage customer and local market preferences, while on
the upstream side firms need transparency to manage their suppliers and so on (i.e. the global
supply chain). Simultaneously addressing considerations associated with both downstream and
upstream challenges are important drivers in how firms design their supply chains and how
these networks have formed in the past. These challenges have accentuated the need for firms
to manage the multi-tiered nature of their supply chains and customers and to contend with
which part of their supply chain to control and which part to let emerge (Choi, Dooley, and
Rungtusanatham, 2001).

Part of the complexity associated with supply chains is that buying firms do not necessarily
know with certainty from where a supplier (first-tier or further upstream) is sourcing or sending
the material. If the supplier has multiple plants, the supplier may feel that sourcing decisions
are fully within their discretionary decision-making power. This may not be a problem from a
product quality standpoint if the plants have identical equipment and production procedures.
However, it can be a concern to the buying firm that is reporting environmental impacts
according to the greenhouse gas (GHG) protocol, in particular, the Scope 3 indirect upstream
activities (e.g. Olhager, 2019; Tidy, Wang and Hall, 2016), given that different plants may exhibit
different GHG emissions standards. These can be exacerbated if suppliers come from a diverse
range of sectors and geographies (Huang, Narayanan, and Swaminathan, 2020). Moving
forward, information on these issues may also better help the focal firm design products with
high quality.

**Resource Endowments**

Effectively managing the flow of goods and services throughout the extended supply chain is
quite challenging, as it involves overseeing the exchange of information, contracts, and finances
between many different actors. Furthermore, large supply networks often involve suppliers
from different technology domains and from different industrial sectors, all of which may have
different supply network characteristics (Carter, et al., 2015). This can result in substantial
variation in how individual firms conduct business and internally manage these activities. In extended supply chains, firms may have different resource endowments.

When we consider resource endowments across a supply chain, we encounter two issues—power (Chae, Choi, and Hur, 2017; Grimm, Hofstetter, and Sarkis, 2016; Kembro et al., 2017; Maloni and Benton, 2000) and supply chain financing (Rogers, Leuschner, and Choi, 2020). Power has been defined as having control and influence over others. A key issue associated with power and the associated imbalances in power between the actors in the supply chain, is exploitation. Generally speaking, the closer supply chain members are to the end customer the more power they have. Large globalized supply chains are increasingly revealing notable power gaps between firms, where the firms with more power (i.e. larger buyers) routinely take advantage of less powerful firms (i.e. small suppliers) by encouraging suppliers to ignore or work around minimum wages, safety requirements, environmentally responsible practices, etc. (e.g. Schleper, Blome, Wuttke, 2017; Sodhi 2015). In the extended supply chain, power gaps need to be actively addressed at multiple levels (e.g. the firm, the community, and the country) through rules and regulations and by promoting responsible supply chain management practices that may involve non-traditional stakeholders such as regulatory agencies and NGOs (Hyatt and Johnson, 2016).

Another important issue that arises from power gaps in extended supply chains is supply chain financing (SCF). Like power, the buying firms closer to the consumers tend to motivate and direct activities in SCF. SCM not only involves the flow of goods and services, but the flow of capital and the various actors are involved in these flows (e.g. Fintechs, banks, credit card companies, government organizations, etc.). A recent whitepaper out of Japan speaks of “deep tier” financing involving suppliers across the extended supply chain driven by the buying firms closest to the consumers (Fintech Association of Japan, 2020). For instance, during the COVID-19 pandemic, many large buyers decided to hold on to their cash assets and either stopped or delayed payments to their suppliers (OECD, 2020). The practice of extending payment terms to their suppliers has become a commonplace in modern supply networks, where terms have extended to 90 days or 120 days from what used to be 30 days. In the end, less resource-endowed, less powerful suppliers often finance the more richly endowed, more powerful buyers. This raises some interesting questions. For example, what would an ethicist say about many deeply entrenched financing practices in supply chains? How do these SCF practices propagate across extended supply chains, particularly in less developed countries? How does the money flow? Who is in the driver’s seat? These issues warrant investigation.

Global vs local supply chains

Concerns about environmental impacts, response times, and trade barriers have pressed firms to shorten transportation distance, reduce lead times, adjust local content and related taxes. These are some of the positive effects associated with shifting away from large global supply chains to shorter and more localized supply chains (e.g. through reshoring) (Ashby, 2016;
Johansson, Olhager, Heikkilä, and Stentoft, 2019). The COVID-19 outbreak has provided increased motivation for this recent movement from global to local supply chains (Xu, Elomri, Kerbache, and Omri, 2020). However, since the reshaping of supply chains require substantial investments, such changes are not likely to happen very fast (Javorcik, 2021).

Firms with global markets can operate via one large, globally connected supply chain involving some of the most highly regarded suppliers in the world, but with a lot of transportation between time zones. To facilitate a single large supply chain, some large buyers divide the globe into three time zones: Americas, EMEA (Europe, Middle East, and Africa), and Asia. An alternative to the one large supply chain model is to establish and work with multiple regional supply chains that each source, make, and deliver within localized markets. For example, we have seen buyers with six local supply chains that operate in parallel for the same product group (Feldmann and Olhager, 2019).

There are many dimensions in which global and local supply chains show different characteristics. Take, for instance, complexity and adaptability. Global supply chains tend to be more complex, but can also be more adaptable as they have more degrees of freedom (e.g. a larger supply base to choose from). Local supply chains tend to be less complex but can also be flexible and responsive to product customization. In the new global landscape for sourcing and manufacturing with new forms and levels of uncertainties, it is increasingly challenging to find an optimal balance when deciding between global versus local supply chains. Managers and scholars will continue to grapple with who should be doing what and where.

**Geography challenges**

Managing extended supply chains becomes more challenging when one considers the extent to which physical and human geography can influence the value dimensions of cost, quality, delivery, responsiveness, and innovation throughout the extended supply chain (Kumar, Narayanan, and Salvador, 2020; Novak and Choi, 2016). In this context, geography is more than just about locations – it involves aspects of both physical and human geography. **Physical geography** focuses on spatial characteristics, distances, and natural phenomena, where barriers are created by natural processes or phenomena and include landforms (e.g. rivers, mountains, oceans), climate (e.g. temperature, rainfall, seasonal differences), and physical distance (e.g. miles or hours from origin to destination). **Human geography** focuses on the interactions between people their communities, cultures, and the environment over time and space, where barriers include social and cultural phenomena such as the borders between countries, cultural divisions, different economic systems, territorial waters, etc. In SCM, we often concentrate on the barriers or risks associated with physical geography; however, the barriers or risks associated with human geography are equally important. For example, Frankel and Rose (2000) estimate that the amount of trade that occurs between countries 5,000 miles apart is about 20% of the amount predicted if the same two countries were only 1,000 miles apart (i.e. physical geography). At the same time, the authors observe that the economic interactions
between different countries substantially increase when the trading partner is a former colony or when a common currency is used (i.e. human geography).

From a business or commerce perspective, physical and human geography can be viewed as dimensions of distance (Ghemawat, 2001), where “distance” (regardless of the particular dimension) presents absolute and relative barriers to the flow of information, goods, and services, influences the formation and evolution of relationships, and directly impacts cost, quality, delivery, responsiveness, and innovation throughout the supply chain. Geography is an often overlooked yet important consideration in SCM, and is particularly relevant with respect to the study of issues centered on managing the extended supply chain, such as direct sourcing, sustainability, governance and control, information sharing and transparency, and logistics integration. For instance, political differences between suppliers at lower tiers of the supply chain can hamper a buyer’s responsiveness to unexpected disruptions in supply – particularly if the disruption affects a product that is associated with a national identify or is country specific. Physical geography influences the structure and design of the delivery network and mode of transportation. Likewise, cultural differences or language barriers between suppliers have the potential to affect service quality and compliance. By expanding the study of supply chains to include distance-based geographical constructs, we can extend conceptual models to include relational attributes to evaluate potential barriers that lie between suppliers located at various tiers in the extended supply chain. This is not just a logical evolutionary development related to supply chain and logistics modeling, but an essential advancement that is critical to successful business operations.

The environment, social and governance (ESG) imperative

Increasingly the society is valuing diversity, equity and inclusion within settings (Kalkanci, Rahmani, and Toktay, 2019; Narayanan and Terris, 2020; Plambeck and Ramdas, 2020. These issues directly tie to the idea of environment as well. Businesses and supply chains also face the important imperative of contributing to societal challenges of climate change, disability, poverty and other serious and emerging challenges across different regions of the world. Naturally, the firms within the networks of supply chains need to act in a manner that is cognizant of not only the goals of the overall supply chains, but also local challenges. This requires a fundamentally different level of collaboration and visibility than what was considered to be acceptable in the past, specifically when considering that supply chains increasingly have multiple tiers. Therefore, an understanding of the extended supply chain is key to superior performance in current environments. Further, consumers are becoming more conscious of product origins. As such, they are increasingly demanding that firms show transparency across the source, make, and deliver stages of the product. Beyond the consumer demands on firms, there are also increasing challenges that local community and stakeholders impose on the firm. For example, pollution, water scarcity are key issues in several firms (Schmidt, 2019).
Many buyers typically work just with their first-tier suppliers and hold them entirely responsible for the products they supply. However, first-tier suppliers depend on what they receive from their suppliers and their supplier’s suppliers. What lies beyond their first-tier suppliers often remains opaque to the buyers. Working only with their first-tier suppliers is of course a viable strategic option. Many large buying companies such as Walmart and Google do well with this approach. It simplifies their task and is often more economical (Muhammad, 2015). However, that is until a disaster like Rana Plaza Accident happens (Market Watch, 2014) and they are at risk of taking a hit on their corporate reputation because, unbeknownst to them, the products they were selling came from a factory in Rana Plaza through Li & Fung (Market Watch, 2014; Melvin and Lee, 2015), their first-tier supplier. Firms serious about sustainability face similar circumstances and they arguably should look deeper into their extended supply chains (Choi and Linton, 2011), as the source of sustainability problems often originate outside of the first-tier suppliers. In one way or another, large buying firms eventually must come to grips of the multiple tiered nature of their supply chains. There are other similar challenges, such as child labor or the desire to make products conflict mineral free. They bring new challenges of integrating resources across the ecosystem of suppliers and their own stakeholders. Such challenges are exacerbated by the realities of climate change crises, and that is likely to impact different parts of the world differently.

**Logistics and Transport**

Logistics is responsible for moving goods and services throughout the extended supply chain. Typically, shippers (i.e. suppliers) outsource logistics and transport work to third-party logistics (TPLs) companies. Interestingly, recent global disruptions have caused a reconfiguration of shipper-TPL relationships. For one, the pandemic has caused a shift of power from shippers to TPLs. This is because the demand for TPLs has increased, and the shippers are leaning more on reliable TPLs as a strategy to control costs (Ashe, 2020) and to reduce delays in the movement of goods.

Global disruptions (i.e. COVID-19) are providing opportunities to explore and cure the long-standing mistrust between TPLs and shippers, which is often the fundamental disconnect of any outsourced relationship. On the one hand, the shippers are not fully aware of the operations of TPLs; on the other hand, they rely on TPLs to meet buyers’ requirements in order fulfillment and delivery. What used to be isolated dyadic relationships between shippers and TPLs and between TPLs and buyers are transforming into an integrated triadic relationship involving shippers, TPLs, and buyers. For example, large buyers such as Microsoft are taking the lead in forming such a triadic relationship. Microsoft outsources the freight management of its hardware to C.H. Robinson, a TPL. The hardware is sourced to suppliers in several countries but mainly in China (Lennane 2019). This recent collaboration between C.H. Robinson and Microsoft aims to scale and develop new solutions which will help all three parties (shipper, TPL, and buyer) to achieve greater supply-chain efficiency, real-time insights and visibility of their goods.
(Eden Prairie and Redmond 2020). It is expected that real-time visibility will dramatically improve Microsoft’s ability to effectively manage risk associated with shipment delays, damages, and losses.

To address extended supply chain issues, it is expected that both shippers and TPLs will form strategic partnerships for managing risk in the coming years. This involves moving away from traditional transactional relationships by allowing TPLs to take more charge of end-to-end (E2E) supply chains. Therefore, we anticipate that reconfigured logistics management strategies will play a critical role in extended supply chains and become part of the new normal in coming years.

**Supply chain risks**

Extended supply chains expose concomitant challenges of supply chain risks. To mitigate risks, many leading buying firms are *mapping their extended supply networks*. Yet it is difficult and time-consuming to do so, and requires visibility into exposures, many of which can be unknown. A recent HBR article (Choi, Rogers, and Vakil, 2020) discuss one Japanese company that mapped their supply networks after the Fukushima disaster. It took a team of more than 100 people over one year to map the firm’s extended supply networks. In another example, immediately following the COVID-19 outbreak and a few weeks of shutdown, a large multinational company based in Sweden spent on average 4 hours talking to each first-tier supplier concerning the status of manufacturing, human resources, inventories, upstream suppliers, etc., in preparation for the restart of their supply chains.

It is known that disruptions in lower tiers of the supply chain can have a substantial impact on buying firms even if the disruptions are associated with relatively small and substitutable suppliers. Such disruptions can come from lack of appropriate processes, non-availability of technology or poor labor management practices. Regardless of the source of disruption, the result can negatively affect the reputation of a buying firm. In general, minimizing the frequency and magnitude of disruptive events requires effective planning and mitigation strategies that identify potential challenges stemming from these diverse forms of risks. *Increasing frequency of black swan events* (i.e. the 1997 Asian Financial crisis, the dotcom crash, 9/11, Japanese tsunami, the 2008 financial crises, Brexit, COVID-19, and the other large-scale disasters) requires us to better consider the extended supply chain as a key research imperative.

With *increasing threats of cyber-attacks*, cyber security is another visibility imperative (Rogers and Choi, 2018). For example, one leading defense manufacturer noted that some smaller suppliers that were software developers operated out of their recreational vehicle and yet had access and connection to their cyber network. These types of risks increasingly expose firms to vulnerabilities, not through their own IT systems, but through suppliers, and downstream customer IT systems throughout the extended supply chain. With COVID-19 and increasing remote work, employees also become a key part of these vulnerability points.
In closing

In current environments, when many supply chains are truly global and span multiple countries, managing the extended supply chain is clearly an important competency and arguably a necessity (if interested in a short video that overviews concepts surrounding extended supply chains by Choi, see [https://youtu.be/8W_LhOF7n1g](https://youtu.be/8W_LhOF7n1g)). As suppliers and customers are distributed across continents and markets, firms need to explore approaches that enable them to better learn about and understand their suppliers and customers to design their extended supply chains. Such an undertaking is incredibly challenging as global supply chains are complex adaptive networks that continually evolve over time and space (Choi et al., 2001). Complexity increases when the scope of analysis expands to consider the management of extended supply chains and the activities of suppliers that are outside of the buyer’s direct sphere of influence. From a buyer’s perspective, proactively assessing risk and attempting to manage relationships between various suppliers throughout the extended supply chain is a daunting task, as the buyer often has limited knowledge or information about the relationships that exist between first-tier suppliers and lower tier suppliers (Choi et al., 2020). As consumers become more aware of sustainability challenges at the lower tier level of extended supply chains, firms need new approaches and strategies to manage these extended supply chains (Choi and Linton, 2011). These conditions involving extended supply chains certainly hold opportunities for researchers in coming years.

References


