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Larger, counter-intuitive and lasting – The PSM role in responding to the COVID-19 pandemic, exploring opportunities for theoretical and actionable advances

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ABSTRACT

PSM has played an important role in the initial mitigation of risks caused by the COVID-19 pandemic. We explore the nature and scope of this role and develop a roadmap for PSM contributions towards greater supply chain resilience. We find that the role of PSM is (1) multidimensional; responding to supply risks but also to demand and logistics risks, (2) counter to game theory; collaboration increased instead of decrease, (3) multi-stage; beyond the initial response the hardest change efforts are still ahead. The pandemic is accelerating the journey towards future-proof PSM but not necessarily revolutionizing the future of PSM.

1. Introduction

In PSM and supply chain literature there have been consistent calls over the years for more empirical and event-based research to complement existing research that is often more conceptual in nature (see for example Costantino and Pellegrino, 2010; Giannakis and Louis, 2011; Sohdi et al., 2012; Ho et al., 2015; Scholten et al., 2020). Pournader et al. (2020) conclude that there is a shortage of research in supply chain disaster relief management and responses to significant disruptions. The COVID-19 pandemic presents a perfect opportunity to begin to respond to these calls (Mollenkopf et al., 2020; van Hoek 2020a). Ketchen and Craighead (2020) state that in the context of the COVID-19 pandemic scholars can add significant value with research that is actionable (ideas that can be implemented) and focused on what responses to the pandemic might work. It is likely that there are several action areas within procurement and supply management (PSM) that might make meaningful contributions to responding and recovering from the supply chain effects of the pandemic. Handfield et al. (2020) point at the value of reconsidering supplier segmentation, van Hoek (2020a) points at the value of reducing reliance on global sourcing strategies. However, Bofelli et al. (2020) conclude that decision making around reshoring, a PSM practice widely called for in the context of the pandemic, are complex, multi-faceted and poorly understood.

Unfortunately however, there has been very limited empirical work on the impact of the pandemic on supply chain risks, the special issue of the Journal of Supply Chain Management for example contains essays and theoretical consideration but no empirical work (Flynn et al., 2021).

The COVID-19 pandemic also provides a unique empirical opportunity as the risks caused by the pandemic are different from typical supply chain disruptions (Swanson and Santamaria, 2021). The impact of the pandemic is causing extreme uncertainty that is longer lasting (Swanson and Santamaria, 2021), very global, sweeping across many industries and throughout the supply chain (van Hoek, 2020b for example, includes cases from retail, logistics, manufacturing and distributors). The Japanese Tsunami or the Longbeach port strike for example cause supply chain risks that are location specific, shorter lasting and easier circumvented by shifting sourcing to other locations and routing traffic via other ports. Even SARS 5 had an impact that was much shorter lasting risk impact that was less sweeping around the globe. However, Queiroz et al. (2020) report a research gap in the understanding of pandemic impacts on supply chains. Based upon a systematic literature review they suggest a research focus that considers both risk initial recovery, as well as, adaptation via re-allocation of supply and response digital technologies. This approach factors in the notion of different time horizons in the responses to supply chain risks caused by the pandemic. Wieland (2021) considers the pandemic impact in terms of cycles of adaption and Harland (2021) argues that knowledge about the stages of mitigation, response and recovery is available but that it needs to yet be woven together effectively (Flynn et al., 2021). This notion of a time horizon and the need to consider different stages or steps in mitigating, responding and ultimately recovering from risks is largely missing in existing supply chain risk literature and likely particularly relevant.
given the longer lasting impact of the pandemic (over 1 year at the time of writing this paper) when compared to previous risk scenarios such as the tsunami or a port strike. In summary:

“There are knowledge gaps in how to address supply chain issues in times of widespread disruption, such as from pandemics and it is important that research be conducted now while the world’s supply chains are reacting to the pandemic changes. Much can be learned during the reaction period of the COVID-19 pandemic.” Swanson and Santamaria (2020), pp.1

It is the purpose of this paper to respond to the calls for more event-based, empirical and actionable research into supply chain risk implications of the pandemic by initiating:

- Empirical exploration of the role of PSM in responding to the COVID-19 pandemic,
- Considering the unique nature of pandemic risks and
- The time horizon of various responses to those risks (from responding to recovering).

We aim to explore how risk management approaches from PSM and supply chain literature might inform PSM’s response to the pandemic. We aim to develop a roadmap for PSM actions and pathways for PSM research, as input to this journal’s efforts to advance research and thinking on PSM’s role during the pandemic.

2. Risk approaches suggested in literature

It is expected that PSM can play a key role in disseminating supply side resilience enhancing practices and capability throughout the supply chain, because of its boundary spanning nature (Pereira et al., 2020). Craighead et al. (2020) assume, from a game theory perspective, that the extreme shifts in supply and demand caused by the COVID-19 pandemic, make upstream and downstream firms’ moves more difficult to forecast and anticipate, putting collaboration at risk. Craighead et al. (2020) also assume, from an event theory perspective that firms that experience huge swings in supply and demand during a pandemic are more likely to change their supply chain processes post-pandemic. This reinforces not only the relevance of exploring which PSM and supply chain risk techniques may be used, it also introduces a time-line for adoption. There may be an initial, during and post-pandemic phase to the response and possible changes in capability development.

Risk management has been studied from a supply management (Zsidisin and Ellram, 2003; Zsidisin and Smith, 2005) and sourcing perspective (Colicchia and Pellegrino, 2010; Vedel and Ellegaard, 2013), from an inventory management (Ballou and Burnetas, 2003; Kang and Kim, 2012), forecasting (Poojari et al., 2008; Kim, 2013) logistics (Cavinato, 2004) and manufacturing perspective (Talluri et al., 2010). In addition to different risk perspectives and possible risk management actions, literature offers a conceptualization of risks considering: (1) risk sources, (2) risk drivers and (3) risk mitigation actions and risk techniques (Juttner et al., 2003; Rao and Goldsby, 2009).

Christopher and Peck (2004) and Mena et al. (2018) list a number of sources and categories of supply chain risks, including supply, demand, process, control and environmental risks. Supply risks pertain to disruptions of upstream and inbound supplies, whereas demand risks pertain to unpredictable fluctuations in downstream demand. Control risks center around disruptions caused by internal control systems, process risks are those risks that have to do with the reliability of supply chain processes and include visibility into bottlenecks and transparency of inventory positions. Environmental risks finally, are external forces that may cause supply chain disruptions. Ho et al. (2015) based upon their extensive literature review, expanded these sources of risk into a broader supply chain scope by adding manufacturing, transportation and financial risks.

Petitt et al. (2010 & 2019) list common risk consequences of widely made supply chain management decisions, including:

- Globalized supply chains as a result of seeking factor cost advantages cause longer delivery pipelines and a greater dependence on a few global source regions
- Specialized factories as a result of seeking economies of scale cause a dependency on just a few factories, often located in a few global regions
- Centralized distribution as a result of seeking inventory reduction lengthen the delivery pipeline to the consumer and increasing stock out risks
- Increased outsourcing raises the dependence on (a few) suppliers
- A reduced supplier base as a result of a focus on negotiation savings results in a dependence on a limited number of suppliers
- Increased volatility of demand results in bullwhip effects throughout the supply chain
- Technological innovations may disrupt processes and controls.

Considering the above risk drivers, literature also offers several possible techniques to manage and recover from these risks. A reduction of the number of suppliers can create leverage in negotiating payment terms and prices but it also increases the dependency on those suppliers for continued supply. Dependency and supply risk is one of the two axes in the Kraljic (1983) segmentation. In this segmentation it is advised that for critical bottleneck supplies companies focus on ensuring supplies, rather than on cost savings, and that for more strategic supplies companies to adopt a more collaborative approach. Padhi et al. (2012) suggest three measures to inform the supply risk positioning in the segmentation and they are the impact of a product purchase on market risk, performance risk and complexity risk. Hesping and Schiele (2016) consider as risk drivers: the availability of alternative suppliers in case of capacity bottlenecks, supply problems or if a supplier is eliminated. Handfield et al. (2020) indicate that COVID-19 has shifted products towards a greater risk profile in the supplier segmentation. The implication being that a greater focus on supplier collaboration and less of a focus on supplier costs may be warranted (van Hoek, 2020b).

Further supply chain techniques that are suggested in literature to combat supply chain risks include active information sharing throughout the supply chain (Wagner and Bode, 2008). Technologies such as RFID and blockchain can accelerate information sharing and improve visibility into inventory positions and logistics flows (Queiroz et al., 2020; Rao and Goldsby, 2009; Pettit et al., 2019; van Hoek, 2019a). This is particularly the case if the information exchange can shift from partial and sequential (one tier at the time) to more fully and instant (van Hoek et al., 2019; van Hoek 2019b). Pettit et al. (2019) also recommend that use of leading risk indicators and event management systems as an alternative to quarterly or monthly reports that provide a “rearview mirror”. Supply chain techniques suggested to combat dependency on a few global suppliers and specialized factories include the use of flexible suppliers (Tang, 2006), ensuring redundant suppliers (Chopra and Sodhi, 2004), building inventory buffers and back up sources (Vanzoucke and Ellis, 2019; Kahn and Burns, 2007), using multiple sources and the sharing risks between supply chain participants and plants (Manuj and Mentzer, 2008).

3. Method

The COVID-19 pandemic is a newer phenomena and supply chains are still very much in flux as we write this paper. They likely will be for some time to come. As a result, an initial exploration seems fitting. Conducting this empirical exploration adds to a very limited basis of empirical data on the supply chain impact of the pandemic and this in and of itself is part of the contribution of this paper, it may serve the opportunity to learn from leaders as called for by Ferdows (2018) and can inform decision making underway in industry today. The currently
available research on the COVID-19 pandemic can benefit from more empirical exploration. For example, Mollenkopf et al. (2020) offer a conceptual approach, Singh et al. (2020) conduct a theoretical simulation, Ivanov (2020) simulate one case study, van Hoek (2020a) offer workshop findings and Handfield et al. (2020) use interviews with 2 supply chain executives of manufacturing companies in two industries, one based in the US, one based in Europe. In order to achieve a broad and richer empirical exploration of supply chain risk management in response to the COVID-19 pandemic we use multiple methods that can complement each other and build upon each other.

This study is structured into two stages; (1) initial exploration using a high-level survey and (2) a further exploration in case studies. The use of this initial exploration using a survey is in line with Goldsby and Zinn’s (2018) call for more multi-method research, combining qualitative and quantitative research when studying complex phenomena. They suggest that survey research can be used to frame, rather than to statistically generalize a problem, perhaps counter to common uses of multi-method and survey research, in that way returning to its descriptive roots. The use of a survey in this stage of research and with this objective is obviously different from the more conventional survey research focused on robust statistical generalization. However, our research explores a terrain where there is very little empirical research in existence today. As a result, we feel that it is more appropriate to use the survey to broadly explore and provide input to the deeper exploration in case studies. Put differently, the current state of research and dynamic developments in industry may not yet make robust statistical generalization appropriate.

A survey was developed with the purpose of initial empirical exploration of the supply chain risk impact of the pandemic. Items included were directly derived from supply chain risk management literature as covered in the previous section. Questions centered around three areas:

1) The degree to which respondents experienced different types of risks from Christopher and Peck (2004), Mena et al. (2018) and Ho et al. (2005),
2) The degree to which drivers of supply chain risks from Pettit et al. (2010 & 2019) are experienced in the context of the pandemic and
3) The degree to which they are using risk responses from Queiroz et al. (2020), Roa and Goldsby (2009), Pettit et al. (2019), Tang (2006), Chopra and Sodhi (2004), Vanpoucke and Ellis (2019) and Manuj and Mentzer (2008) are used.

The later questions was broken out into three time horizons (short term, mid-term, longer term) to help explore the relevance of considering different time horizons in risk mitigation, response and recovery as suggested in literature (Harland, 2021) but previously missing from empirical supply chain risk research.

The survey was distributed to 79 supply chain managers using a convenience approach inviting supply chain managers participating in a certificate program, an EMBA supply chain capstone class and personal industry connections from the authors around the world. While a convenience sample, we were able to engage managers representing companies in a wide range of industries, including logistics, manufacturing and retail and a range of roles including chief procurement officer, supply chain managers and supply chain SVP. Respondents originate from both Europe and the US. While it is obviously not possible to conduct a thorough statistical analysis on this survey data, it does provide a further exploration as beneficial input to the discussions with managers. In the approach suggested by Goldsby and Zinn (2018) the data helps explore and frame.

Building upon this initial framing we conducted case study interviews to further explore, in greater detail “the story behind the numbers”. This enables us to go beyond the descriptive statistics and into more detail about managerial experiences and insights from practice that might inform the development of a roadmap for responding to supply chain risks caused by the pandemic.

Nine companies were interviewed via multiple interviews aiming to seek feedback on our survey findings and to develop a roadmap of actions PSM and supply chain managers can take in response to the pandemic. Table 1 lists the interview protocol. Table 2 offers an overview of the case companies. We selected the case companies in an effort to involve multiple supply chain positions (retailer, logistics, manufacturer, upstream supplier, distributor, e-commerce), industries (electronics, aerospace, equipment) and parts of the world (Europe, Middle East, Latin America and USA). While this does not allow for generalization about any specific part of the supply chain, any geography or industry, it does enable a broad exploration, not limited to just sections of industry or the supply chain. It also enables initial exploration in an international setting, all of which seemed fitting given the global impact of the pandemic, not limited to a specific part of the world or just a few industries or supply chain positions.

In summary, our study can be characterized as initial exploration, which may be fitting for the early stage of research in this field. While perhaps less rigorous and comprehensive, we hope that this notes and debates paper can inspire and inform the stream of research under development for the future special issue of this journal and other journals.

4. Survey findings

Table 3 shows risks from literature as rows and, in the columns, the qualitative scale, ranging from “not experiencing this type of risk” to “experiencing this risk greatly” the percentage of respondents selecting this response option. The percentages in the cells represent the share of respondents to the survey that reported experiencing this type of risk, to that degree. So for example, the 9.09% in the very top left cell means that 9.09% of respondents indicated that they are not experiencing supply risks.

Supply and demand risk rank the highest off all items in the “clearly experiencing” whereas manufacturing, process and control risks score highest on “somewhat experiencing.” Logistics and financial risks are more distributed across the answer options, implying a more mixed picture. While this does confirm the relevance of considering manufacturing and logistics risks, in addition to demand and supply risks, as called for by Ho et al. (2015), the table does imply that demand and supply may be the most dominant risk with manufacturing and logistics risks being experienced perhaps consequentially and depending upon the supply chain position of the company. The good news from the table may be that process and control risks are experienced comparatively less so, implying that respondents are able to keep processes and controls in place.

Table 4 shows scores for the degree to which risk drivers from literature are experienced by respondents. The rows list risk drivers from

| Table 1 | Interview protocol. |
| --- | --- |
| - Is your supply chain impacted by COVID-19? If so how? |
| - What challenges did and does your supply chain face more specifically? (risk sources) |
| - What has driven those supply chain risks? (inquire about risk drivers) |
| - How is your company responding to these risks? |
| - Are you considering adjusting the supply base? |
| - If so, in which way are you doing this? (if needed inquire about multiple sourcing, local and nearshoring, reducing the reliance on single/few factories) |
| - Is your company increasing inventory buffers? |
| - Is your company engaging with suppliers to address supply issues? |
| - If so in what way and what is the role of procurement? (if needed inquire about extending payment terms, negotiating discounts, joint mitigation efforts, inquire if the approach is segmented or not) |
| - Is your company considering technologies to address supply chain challenges? (if needed inquire information sharing, visibility and event management systems) |
| - Is your company planning changes to its supply chain for after the COVID-19 pandemic? If so, what are they? |
Table 2
Overview of dataset.

| Industry               | Company 1            | Company 2          | Company 3         | Company 4             | Company 5          |
|------------------------|----------------------|--------------------|-------------------|-----------------------|-------------------|
| Supply chain position  | Tools and DIY products | Logistics services | Retailer          | Electronics           | Fitness and outdoor equipment |
| Geography              | Manufacturer         | Logistics          | Retail            | Distributor           | E-commerce company |
| Company size           | USA                  | USA                | USA               | USA                   | USA               |
|                        | Small-medium size    | Medium size        | Large size        | Medium sized          | Small sized       |

Table 3
The degree to which respondents are experiencing different types of risks in the context of the pandemic.

| Risk driver not applicable | Somewhat experiencing this type of risk | Clearly experiencing this type of risk | Experiencing this type of risk |
|----------------------------|----------------------------------------|---------------------------------------|-------------------------------|
| Supply risks               |                                        |                                       |                               |
| Demand risks               |                                        |                                       |                               |
| Manufacturing risks        |                                        |                                       |                               |
| Transportation risks       |                                        |                                       |                               |
| Process risks              |                                        |                                       |                               |
| Control risks              |                                        |                                       |                               |
| Environmental risks        |                                        |                                       |                               |
| Financial risks            |                                        |                                       |                               |

Table 4
The degree to which risks drivers are experienced by respondents.

| Risk driver not applicable | Somewhat experiencing this type of risk | Clearly experiencing this type of risk | Very much experiencing this type of risk |
|---------------------------|----------------------------------------|---------------------------------------|-----------------------------------------|
| A highly globalized supply chain |                                        |                                       |                                         |
| A limited number of specialized factories |                                        |                                       |                                         |
| Centralized distribution |                                        |                                       |                                         |
| Increased outsourcing     |                                        |                                       |                                         |
| Increase volatility of demand |                                        |                                       |                                         |
| Proliferation of products & services |                                        |                                       |                                         |
| A reduced supply base     |                                        |                                       |                                         |
| Technological innovations |                                        |                                       |                                         |

literature, the columns represent the qualitative scale ranging from “Risk driver not applicable” to “Very much driving risks experienced”. The percentages in the cells represent the share of respondents that indicated that level of experiencing that particular risk driver. The 12.50% in the very top left cell for example, means that 12.50% of respondents indicate that “a highly globalized supply chain” is not an applicable risk driver for them.

A highly globalized supply chain and increased volatility in demand score the highest in “clearly driving risks experienced”, “very much driving risks experienced” and the lowest on “not applicable”. This may help understand the high scores for demand and supply risks reported in Table 3. Other drivers have higher scores for “not applicable”. Reduced supply base, limited number of factories and proliferation of products and services score higher in clearly driving and very much driving than the remaining drivers. Centralized distribution and technical innovations have the highest percentage scores in “not applicable”. These drivers shed extra light on the risks experienced and may inform risk mitigation techniques reportedly used by respondents.

Perhaps most interestingly, Table 5 shows the usage of supply chain risk management techniques from literature (in rows) as reported by survey respondents. We consider three time horizons; short term risk mitigation, mid term risk recovery and longer term structural derisking of the supply chain in response to the COVID-19 pandemic, these feature as columns in the table. The percentages in the cell represent the share of respondents that report using the technique with that particular time horizon. The 13.48% in the very top left cell for example means that 13.48% of respondents indicate that they do not use inventory buffering as a risk management technique in the context of the pandemic. Note that those respondents that indicated using a particular technique could pick multiple time horizons; they could indicate to use a particular technique in short, mid and longer term actions, only in the short, mid or longer term or any combination of the three time horizons.

The table does indicate that different techniques hold relevance against different timelines indicating the relevance of considering time horizons of risk management techniques. Inventory buffering for example is used as a short term technique by almost 42% of respondents and only by 17.98% of participants as a longer term effort. The reversed appears true for collaboration with strategic suppliers; this is a longer term focus for 45.59% of participants and of short term relevance for only 21.32% of participants. The focus on reducing reliance on single factories and the use of information technology event management systems to increase visibility appear the most likely to not be used as techniques.

These datapoints do imply that there are different risk management approaches in the supply chain by time horizon and that a multi-faceted approach to managing response to the events is considered, in line with literature. The data also further indicates that there are collaborative effects of the pandemic and that collaboration may actually increase over time, instead of reduce as could have been assumed based upon game theory. The role of PSM in developing capability in the supply chain includes a focus on both savings and collaboration, confirming PSM’s role in balancing competition and collaboration and in rolling out risk management efforts throughout the supply chain.
sures of factories elsewhere in Asia and in the USA after that. This factory closures in China, later on supply risks were driven by the clo
company 1 experienced plenty of supply risks, initially as a result of the and inventory buffering to reduce the risk of supply shortfalls. Case
management technique from literature, in the short, mid and longer-
ture pursued. Based upon our survey findings and these case interviews
Table 5 offers an overview of case interview findings on risk sources

| Do not use this risk management technique | Use this technique as part of short term risk mitigation | Use this technique as part of 3-6 months recovery efforts | Use this technique as part of longer term efforts to make the supply chain more resilient |
|------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------|
| Inventory buffering                       | 13.48%                                                | 41.57%                                                 | 26.97%                                                       | 17.98%                                                       |
| Reduce reliance on single/few factories   | 17.05%                                                | 14.77%                                                 | 21.59%                                                       | 46.59%                                                       |
| Ensure multiple flexible and alternative sources | 3.85%                                                | 20.19%                                                 | 27.88%                                                       | 48.08%                                                       |
| Include near and local sourcing in the supply chain | 10.38%                                              | 32.08%                                                 | 24.53%                                                       | 33.02%                                                       |
| Active information sharing throughout the supply chain | 3.79%                                                | 30.30%                                                 | 30.30%                                                       | 35.61%                                                       |
| Use information technology to improve visibility into demand and transparency of inventory | 10.16%                                                | 24.22%                                                 | 26.56%                                                       | 39.06%                                                       |
| Use event management systems and leading risk indicators | 17.74%                                               | 25.00%                                                 | 27.42%                                                       | 29.84%                                                       |
| Focus on ensuring supply and collaboration with strategic suppliers | 1.47%                                                | 21.32%                                                 | 31.62%                                                       | 45.59%                                                       |
| Negotiate savings and payment terms with selected suppliers | 9.52%                                                | 26.98%                                                 | 30.16%                                                       | 33.33%                                                       |

5. Towards a roadmap – findings from interviews with managers

Table 6 offers an overview of case interview findings on risk sources and drivers experienced and risk management techniques from literature pursued. Based upon our survey findings and these case interviews Table 7 offers recommended PSM and supply chain actions, by risk management technique from literature, in the short, mid and longer-term that companies can consider.

5.1. Short-term actions – inventory buffering in response to global supply and demand risks

In the short term companies adopted a focus on day to day inventory management, ensuring critical supplies in collaboration with suppliers and inventory buffering to reduce the risk of supply shortfalls. Case company 1 experienced plenty of supply risks, initially as a result of the factory closures in China, later on supply risks were driven by the closures of factories elsewhere in Asia and in the USA after that. This discontinuity of supply impacted the company’s manufacturing operations and its logistics pipeline. Not only did the company ran short on supplies at times, it also needed to realign transportation flows and it had to deal with (temporary) scarcities in transportation capacity during periods of demand peaks. This introduced control risks, resulting from partial visibility into demand and supply. The company also experienced supply and logistics opportunities. When the automotive industry started scaling back its production levels in response to a reduction in demand, more steel capacity became available in the markets and prices improved also. In the words of the company’s procurement director:

“We are managing inventory and orders very actively on a day to day basis. There were some opportunities in steel for example due to a reduction in demand in the automotive industry.” Supply chain director

During this period there was also more transportation capacity available in the market that the company was able to benefit from. The company’s supply chain team is very much focused on tracking and positioning inventory and capacity in order to keep its process and controls functioning. Case company 6 manufacturers vision products (glasses, contacts), the majority of which are manufactured in China. As a result, the company faced supply risks and the dependency on a few sources in China increased these:

“We have some designs that are done in Italy but our manufacturing is predominantly concentrated in China and that caused supply risks.” Chief procurement officer

However, as the pandemic spread supply risks became not solely driven by Chinese sources. Case company 7, the aerospace manufacturer from Europe, has a fairly globalized supply chain that is heavy on Asian sources and one that involves 4000 parts for certain products, introducing many bottleneck supply situations;

“Our supply-base is somewhat Asia-heavy and we need to reconsider that but we have suppliers all over the world. If I am missing 1 out of 4,000 parts in a product I do not have a finished product.” Director of procurement.

In addition to buffering inventory case companies also report short term efforts to shift orders between suppliers and locations. Case company 1 and 5 followed the advice from literature to utilize alternative sources, multiple source locations and suppliers and create flexibility by actively managing demand and inventory between those. It should be noted however that they were able to do this because they had started implementing alternative and additional sources and suppliers several months ago in response to an earlier risk (the US- China tradewar). Had it not done that it would have taken longer to identify and implement new suppliers;

“When the tariffs kicked in, we accelerated supply base diversification to reducing our reliance on Chinese sources. We included suppliers in India and the US. For example when China went into shut down because of COVID-19, we were able to shift orders from Chinese suppliers to those new suppliers in India and Southeast Asia. By the time India and Southeast Asia went into shutdowns Chinese suppliers where back up and running so we could shift orders back to China. This gave us a huge dividend on our diversification efforts.” Procurement director.

In addition to supply risks demand risks also played a role in the shortterm. For case company 7 a main demand risk is the fact that demand for their product and service nearly completely came to a halt due to the lack of airtravel during the pandemic. This resulted in financial risks due to lack of revenue and large supply risks. The company has a lot of specialized suppliers of highly specific and customized parts that suppliers can not sell somewhere else and initially suppliers continued to ship products ordered, creating greater financial strain on the case company. If the case company stops ordering for an extended period the suppliers, that it is highly dependent upon, may stop producing and go
out of business altogether;

“If we do not order anything the rest of the year and next year, by the time we show up in 2021 with a need, the supplier may not be there anymore.”

Director of procurement.

Alternative to this demand risks, case company 2, 3, 5 and 8 experienced growth in demand that drove PSM focus. Case company 5, the e-commerce company for example, almost exclusively sourced from China and the company faced substantial supply shortages. On the demand-side however it faced demand increases further triggering a supply squeeze:

“We source almost exclusively from China and when supply slowed down we were looking at a few more weeks of inventory in transit. While this was happening demand for several of our product lines really accelerated, in fitness for example we have product that sells out in hours the moment we release new inventory to our website.”

In summary, in the short term companies actively managed inventory and supplies with key suppliers, many of whom they are very dependent upon. However, this was not a China-only issue; as the pandemic spread other parts of the world were equally impacted and companies needed to manage supply across their global supply network, including the shifting of orders between plants. Additionally, these actions were not only driven by supply risks, changes in demand also drove substantial focus on these efforts.

5.2. Mid term actions – accelerating key projects and focusing on collaboration

In the mid term timeframe of 3–9 months after that start of the pandemic case companies reported several additional actions, mostly focused on accelerating PSM efforts already underway to diversify the supply base, nuance global sourcing strategies and pursue digitization,

| Case 1 | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 | Case 7 | Case 8 | Case 9 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Manufacturer tools | Logistics services | Retailer | Electronics Distributor | E-commerce | Manufacturer | Vision products | Aerospace | Flooring |
| Sources of supply chain risk | | | | | | | | |
| Supply risk | +++ | + | ++ | ++ | +++ | +++ | ++ | ++ |
| Manufacturing risk | + | - | - | - | - | - | - | - |
| Transportation risk | + | + | - | - | + | + | + | + |
| Demand risk | - | + | ++ | + | + | ++ | + | + |
| Process risk | + | - | - | - | + | + | + | + |
| Control risk | + | + | - | - | + | + | + | + |
| Environmental risk | ++ | ++ | + | ++ | ++ | ++ | + | + |
| Financial risk | + | + | + | + | + | + | + | + |
| Drivers of supply chain risk | ++ | + | ++ | + | ++ | + | ++ | ++ |
| Globalized supply chains | +++ | - | + | ++ | ++ | ++ | + | ++ |
| Specialized factories | ++ | - | + | ++ | +++ | ++ | +++ | +++ |
| Centralized | - | + | + | - | - | - | - | - |
| distribution | | | | | | | | |
| Increased outsourcing | +++ | ++ | - | - | + | + | ++ | + |
| Reduced supplier base | + | - | - | - | - | - | - | - |
| Increased volatility of demand | - | +++ | ++ | +++ | ++ | + | + | + |
| Technological innovations | - | - | - | - | - | - | - | - |
| Risk management techniques in the supply chain | | | | | | | | |
| Reduce reliance on single/few factories | +++ | - | - | - | + | + | ++ | +++ |
| Ensure multiple, flexible and alternative sources | ++ | - | + | - | + | + | ++ | +++ |
| Include near and local sourcing in the supply chain | - | - | - | - | + | + | ++ | ++ |
| Inventory buffering | +++ | - | + | +++ | - | + | + | + |
| Active information sharing throughout the supply chain | +++ | ++ | +++ | + | - | + | + | + |
| Use information technology to improve visibility into demand and transparency of inventory | + | - | + | - | - | + | + | + |
| Use event management systems and leading indicators | - | - | - | - | - | - | - | - |
| Focus on ensuring supply and collaboration with strategic suppliers | ++ | +++ | +++ | +++ | +++ | +++ | +++ | +++ |
| Negotiate savings with selected suppliers only | + | + | ++ | + | - | - | - | - |

Key: = not applicable, + = slightly applicable, ++ applicable, +++ = highly applicable.
in collaboration with suppliers. Case company 1 indicated that inventory buffering is less feasible as a mid to longer term action and that different approaches are needed in this timeframe;

“Investing in inventory may only kick the bucket down the road. When one of our main suppliers was hit by a tornado last year we were able to move orders to another supplier in another region. Whereas dual and multiple sourcing gives you flexibility, a month of extra inventory would have only given you a month delay of the effect.” Procurement director.

Both case company 1 and 5 accelerated their efforts underway to geographically diversify the supply base and grow near and local sourcing options;

“We were already developing new Asian suppliers and in search of capacity to meet growing demand and need for greater response capability in the supply base we reengaged with a local supplier in our home market that we had spoken to in the past to see if we could accelerate bringing them into our supplier portfolio and reduce our dependency on global and Chinese suppliers.” Supply chain director.

On top of these efforts, case company 3 also accelerate existing technology projects and a move towards e-commerce already underway;

“A lot of our digitization projects are in accelerated mode due to the rapid move towards e-commerce and we are also looking at new projects such as contactless self check out,” Supply chain manager.

The approach of suppliers in the mid term shows a balance between competition and collaboration. Case company 9 needed to seek payment and price concessions of its suppliers;

“When demand slowed down we needed to seek extra support and extended payment terms from our suppliers in order to manage our cash position” Supply chain manager.

However, case company 1, 5 and 8 went a different route with payment terms and started paying earlier to support suppliers;

“We reduce from net 60 days payment terms to paying upon shipment so that suppliers could use the early payment to secure material in the market and turn to our next order right away. We are doing what we can on our end to get priority and ensure supply.” Procurement Director case company 1

While facing changes in demand, case company 2 resisted the temptation to utilize the softness in the transportation market to push on suppliers for reduced prices too much and instead took a collaborative approach towards transportation companies. The company focused on continuing to work with most suppliers reasoning that a slightly reduced volume for all is better than taking a few out of business. The rational for this was that the company hoped to not only support its customers during a down period but also invest in its suppliers, hoping that in the long run this will pay off in all those relationships, including when scarcity of capacity resurfaces. According to one of the company’s managers:

“Sustainability and partnership with trucking companies are a key priority for us and you don’t risk throwing years of efforts in the development of relationships away overnight for a short-term discount.”

In summary, in the mid term companies can accelerate efforts to diversify their supply base by including additional suppliers and source locations, as well as nuanced global sourcing strategies by considering ramping up local and nearshore sources. Digitization projects that may have already been underway can be accelerated to improve risk management capabilities and PSM plays a role in managing terms and collaboration with suppliers in response to risks. This response balances seeking terms concessions to support cash position with paying earlier to support supplier efforts to ensure supply and stepping up collaboration to jointly navigate risk recovery efforts.

5.3. Longer term actions – hardest work still ahead

Consistent with survey findings, case companies report a longlist of longer term PSM and supply chain actions mostly centered around the fact that many of the recommendations from literature can not be implemented in the short to mid term. Case company 4 recognizes digitization of the supply chain as a potentially valuable strategy but this is not seen as a change that can not be implemented overnight;

“Digitization does not help in the short term, if it will help in the future, we will see.” Logistics manager.

Equally so, further diversifying the supply base is seen as important but not an overnight solution by case company 5.
“We know that we need to diversify the supply base, also to accommodate growth. In the process we need to reduce exclusive reliance on a few suppliers. This can not be done overnight, we need to identify, evaluate, quality suppliers, next we have to develop molds and start up production.” Supply chain director.

“We learned that a fair amount of spare capacity in the system can be very beneficial when you are disrupted and that is something we need to consider in our future supply chain design.” Chief procurement officer case company 6.

Interestingly several case company 7. Chinese suppliers have decided to start up operations in the US in order to avoid tariffs and meet the growing demand for volume and speed. This may represent an interesting twist to the geographical rebalancing of supply lines widely considered today; if not the manufacturer, it may be the suppliers driving this. Overall however, the company’s chief supply chain officer indicates that this is just the start of a longer change process;

“There is a lot of hard work ahead of us still.”

This quote may be the one recommendation missing from Table 7; the reality that a lot of work to improve risk management capability in the supply chain may still be ahead of us. We hope that managers will not step away from the work ahead and the learning opportunities in front of them. We hope that our research can inform and inspire learnings and derisking actions in industry.

6. The role of PSM and implications for management

Our findings indicate that PSM is playing and has a key role to play in responding to the COVID-19 pandemic. This role is multifaceted and multi-directional, involving both collaborative and competitive actions with suppliers, driving a nuanced of existing global sourcing strategies and advancing digital PSM capabilities. PSM does indeed have a boundary spanning role that involves active inventory management with suppliers, reallocating orders across the supply-base and developing response to demand risks with suppliers. PSM is not solely focused on supply risks but also involved in responding to demand risks and other risks, including manufacturing and logistics risks.

In responding to the pandemic there are different time horizons in play and the majority of recommended actions from literature, while relevant, are most relevant against the longer time horizon, less so in the shorter term immediate response. In the shorter term PSM managers engage in inventory management, ensuring supplies, managing payment terms as they face a (temporary) growth in bottleneck suppliers.

For managers the implication of these findings is that PSM can be recognized, not just as a boundary spanner, but also as a function that can contribute to the response and mitigation of many types of risks, not just supply risks, and that has a wide range of techniques and possible response directions at its disposal. Recognizing the fact that there are multiple timelines to responses managers have much work ahead of them still to grow supply chain resilience and we hope that they will not stop short of taking those actions once the worst of the pandemic is over. Additionally, the pandemic is leading to an acceleration of future-proofing work in PSM already underway to nuance global sourcing strategies, diversify the supply base for lower risk and greater responsiveness and to digitize the supply chain. This does not necessarily represent a revolutionary approach but rather an acceleration of change that will take more time to complete.

7. Implications for PSM research

This paper has made initial progress in extending PSM and supply chain risk management literature by responding to the calls for more event based and empirical research on risk management that is actionable in the context of the pandemic (Ketchen and Craighead, 2020). This comes at a time that the PSM research community faces an incredible opportunity to grow its societal contribution and support the hard work going on and ahead for PSM managers around the world.

From a theoretical perspective we find, consistent with Perreira et al. (2020) who point at the boundary spanning role of PSM in risk management, that PSM indeed plays a large boundary spanning role in responding to the pandemic. But this role appears to be larger than traditionally assumed. PSM not only focused on supply risks, it is also directly involved in responding to demand, logistics and other risks.

Craighead et al. (2020) assumed, using a game theory perspective, that the extreme shifts in supply and demand caused by the COVID-19 pandemic make upstream and downstream firms’ moves more difficult to forecast and anticipate, putting collaboration at risk. Our respondents and participating companies do report large supply and demand risks in their supply chains. But we also find that, counter to what game theory would assume, collaboration with suppliers has been on the rise since the start of the pandemic. This is driven by the fact that more suppliers started falling into the bottleneck segment (as predicted by Handfield et al., 2020 and van Hoek, 2020b) triggering a greater focus on collaboration to enable supply. Specific collaborative actions taken, include active day to day inventory management with suppliers, paying suppliers earlier and invested in as much inventory as they could to grow responsiveness to demand changes. Paying suppliers early and building up inventory represent good examples of departures from well-established PSM policies focused on extending supplier payment terms to improve cash flows and requesting favorable supplier delivery tables to reduce inhouse inventory levels.

In line with Craighead et al. (2020) who expect that companies will alter their supply chains during and after the pandemic, there is capability development taking place as PSM managers respond to the pandemic with multiple time-lines involved. The majority of work on capability development is still to be completed. This capability development is not along entirely new lines, rather it drives an acceleration of capability development already underway in the areas of supply diversification and digitization.

As a result, our initial empirical exploration of supply chain risk management in the context of the pandemic finds the role of PSM to be larger, counter-intuitive and longer lasting.

From an actionable perspective, we find that the actions recommended in PSM and supply chain literature are relevant and widely considered. We also find however that these actions are most relevant in the longer term and less valuable and feasible in the shorter to mid term time range. This time horizon perspective was previously missing from research and the roadmap that we develop may support PSM consideration and actions (as called for by Ketchen and Craighead, 2020). We find that there are additional actions that PSM managers can take in the short to mid term time frame, including active inventory management and shifting orders between suppliers and dynamically across geographies.

While our research makes a contribution as the first multi-method empirical exploration of the impact of the pandemic on PSM, much more research is needed. It was not possible based upon our initial exploration to begin to parse out differences in risks experienced and risk techniques considered between respondents and companies from different parts of the world and in different industries. It would be worthy further exploration to collect additional survey data, enabling the comparison of risks, drivers and techniques between respondents in different parts of the world, in different industries and supply chain positions. Further empirical investigation can also go deeper and travel further into the roadmap towards a more resilient supply chain. Several new research questions can be generated based upon our findings. For example, while the pandemic may drive an acceleration of certain capability development programs, does this come at the cost of a reduction in focus on others? Specifically, while the pandemic may reduce the environmental footprint of businesses, due to the reduction in business travel and commuting to work, supporting environmental
sustainability efforts, the question is if this will be a short term temporary improvement or a stepping stone for progress. Equally so, when it comes to social sustainability, the pandemic may drive a reversal of progress. Because buyers are not able to visit suppliers and conduct audits and because buyers are scrambling to introduce new sources of supply to cope with bottlenecks the ability to enforce social standards may suffer. This question deserves research focus, is there a setback? Can this provide an avenue into more scalable approaches to supplier audits? Audits have always been very time consuming and companies have been limited in their auditing ability as a result – perhaps the pandemic will drive the creation of more scalable audit approaches? … value of empirical is that it shows findings counter to theory assumptions!!!

8. Conclusion

PSM managers in very different industries are rising to the occasion and are offering response and mitigation to several different risks experienced in the context of the COVID-19 pandemic. They are adopting mitigation techniques in the short, mid and longer term and they have a lot of work still ahead of them. As a result, we found the role of PSM here to stay, larger and counter to several theoretical assumptions and we advance the understanding of actions PSM managers can consider and take. The pandemic also provides an opportunity to grow societal value of PSM research and for researchers to contribute to recovery efforts and efforts to structurally improve supply chain resilience, for the good of our discipline, for the good of business at large and for the good of the world in which we live.

Author statement

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Declaration of competing interest

There are no conflict of interest.

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