What we learned from the supply chain crisis: reasons and potential solutions to improve future resilience

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1. Introduction

The pandemic has been interesting from a supply chain perspective. On the positive side, the term supply chain (SC) is now mainstream: "*The world has gotten a crash course in supply chain management in recent years" (*Tamblin, 2021, p5). On the negative, supply chain performance is questioned, and the lack of SC resilience is highlighted: "*Our supply chains are broken. We face many obstacles that will be with us for the coming months, and possibly years*" (Supply Chain Quarterly, 2022). While the pandemic obviously was hard to predict, it was the perfect storm that painfully exposed how vulnerable many SCs actually were. Emerge (2022, p.4) notes: "*The pandemic exposed a lot of the fragility of the supply chain and how tightly synchronized that was*". Similar observations are made across a range of reports, concluding that supply chains have been flipped on their heads and remain in need of repair (e.g., Alicke, et al. 2021: Timmermans, 2021, Geary, 2022). Highland (2021, p.5) add: "*it's important for organisations to realise, and explicitly acknowledge, that those supply chains performed how they were built to operate – short, tight and just in time."*

2. Problem Statement

As the pandemic clearly showed, the existing Supply Chain Management (SCM) approach did not work well and thus both academia and practice realize the need for a new approach to SCM as well as SC resilience. The purpose of this paper is twofold: first to understand the supply chain crisis – the reasons the SCs broke down. We need to revisit and reevaluate current SCM/SC resiliency approaches, and the assumptions behind the approaches. Second, by understanding the reasons for the crisis, and the current state, we can identify gaps in existing assumptions to SCM/SC resiliency in current practices as well as in research. Companies need to understand why the existing approach did not work and what can be done to improve SCM/SC resilience in the future. By analyzing existing practices and assumptions, we can offer both potential short-term and long-term practical solutions as well as suggestions for future research leading to a better understanding of the concepts of SCM/SC resilience. This leads to two research questions:

RQ 1: what are the reasons behind the SC crisis?
RQ 2: what are potential solutions to improve future SCM/SC resilience?

3. Previous Literature

The break-down of SCs can partly be attributed to the resiliency approach by many companies. Despite a general assumption that it is good to be resilient (Wieland and Durach, 2021), it is unclear what resilience actually means. First, as Wieland and Durach (2021) point out, many organizations have approached resilience from an engineering perspective, and "*engineering resilience promotes rigidity, which, in many cases, is in stark contrast to what would feel intuitively right."* (p.318)

This is particularly apparent for larger crises (e.g., political, economic, societal, and ecological) that influence SCs, where SC rigidity might even worsen the crises. Second, in line with Gartner's (2021) SC resilience definition[1], significant SC research (see, e.g., Christopher and Peck 2004; Sheffi, 2005; Sheffi & Rice, 2005; Brandon-Jones et al., 2014, p.58) imply that the system has the ability to "bounce back", that is return to its original state and normal performance within an acceptable period of time, after being disturbed. Yet the idea of bouncing back may not work in the post pandemic era. As the SCs were not resilient, it seems as if bouncing back to something that did not work is not a great idea.

Third, the low-cost focus, as illustrated by a lean approach to achieve efficient processes and SCs is now questioned: "*The countless stock delays and shortages over the past 18 months – caused mainly by a lack of readiness for pandemic-induced disruption – have, for the first time in decades, called into question the running of lean supply chains designed to boost efficiency and profitability*" (Pickup 2021, p.8). The low-cost focused strategies, exemplified by single sourcing from China, meant that the SCs were designed for efficiency and profitability, but they were also fragile (Wieland, 2021). Fourth, SC visibility -- the ability to see from one end of the pipeline to the other (Christopher and Peck, 2004) -- is often mentioned as important for both SCM and SC resilience as having accurate data and information would make organizations aware of risks and thus prepared to take appropriate actions (Jüttner and Maklan, 2011; Wieland and Wallenburg, 2013). However, empirical survey evidence of the impact of visibility on SCM/SC resilience is largely absent (Rao & Goldsby, 2009; Brandon-Jones et al., 2014) and the pandemic has highlighted the lack of visibility. "*The flaws in traditional supply chain processes, which significantly lack visibility, were evident previously, but it took a black swan event in the form of a global pandemic to finally break them"* (Highland, 2021, p.5).

Both before and during the pandemic, several researchers have suggested new approaches to SC resiliency. Wieland and Durach (2021), for example, highlight the need to view SCs as socio-ecological systems where SC resilience is "*the capacity of a supply chain to persist, adapt, or transform in the face of change"* (p.316). Similarly, Novak et al. (2021) argue against the bounce-back approach as SCs are complex systems affected by external circumstances but also by the independent actions of the many actors in the system. In this perspective, organizations need to work both proactively and reactively in order to increase resilience, on the strategic as well as on the process levels (Ivanov and Dolgui 2019).

4. Methodology and Data

Empirical data were collected through qualitative semi-structured interviews with SC senior executives (15+ years of experience from global SCM) from a variety of industries in Scandinavia and the United Stated. We conducted 17 interviews with the aim to reach theoretical saturation (McCutcheon and Meredith, 1993). Applying selection criteria (Miles and Huberman, 1994), a desirable diversity was achieved with a spread of industries such as, for example, automotive, telecom, information technology, and fast-moving consumer goods. Qualitative interviews provided the opportunity to acquire in-depth information based on the respondents' perceptions and experiences (Eisenhardt, 1989; Edmondson and Macmanus, 2007; Hennink and Hutter, 2011;

[1] "*Supply chain resilience is the ability of an organization to avoid, absorb and recover from the business impact of major disruptions through a risk-balanced approach to product, supply chain strategy and network design*".

Brinkmann and Kvale, 2015). The study focused on analytical generalization and painting a rich picture of the SC crisis and SCM/SC resilience practices (Yin, 2014).

The interviews were conducted by two authors following a structured protocol to improve transparency and reduce interviewer bias. Three topics/questions guided the interviews: i) reasons for the current SC crisis; ii) solutions to the current crisis; iii) actions that companies can take to improve SCM/SC resilience. Two levels of coding (Miles and Huberman, 1994; Ellram, 1996) were conducted. First, we applied open coding to identify information-centric terms. For example, related to reasons, each frequently mentioned reason for the SC crisis was given a tentative code/name (e.g., "low-cost focus", "lack of information sharing"). Similar analysis was done for potential solutions to the SC crisis and for actions to improve SCM/SC resiliency, resulting in a set of codes (e.g., "multiple suppliers, "reshoring"). Second, we applied axial coding to compare and contrast our findings and to identify patterns and themes between the first-level codes. Inspired by the Gioia method for structuring data (Corley and Gioia, 2004; Gioia et al., 2013), this analysis resulted in identifying underlying causes for lack of SC resilience and themes across the interviews. This stepwise analysis led to the identification of a "pendulum shift" across a range of areas to improve SCM/SC resiliency (e.g., "increased inventory", "flexible capacity", "vertical integration").

5. **Findings**

As discussed by all respondents, In the following sections we will first present the reasons for the SC crisis based on our interviews. We will then present potential solutions. Based on our analysis of the interviews, we developed what we call "pendulum shifts" in terms of potential future approaches to SCM/SC resiliency.

5.1. Reasons for the supply chain crisis

The SC crisis was obviously caused by the pandemic. Interestingly, with only one exception, the respondents did not blame politics or government actions for the SC crisis. Neither did the respondents use the shift in consumer behavior (e.g., with a rapid increase in e-commerce) as an excuse. As one respondent said: "*There has been supply constraints – but overall, this has not really been the main issue.*" Rather, the respondents mean that companies have to blame themselves. While various reasons for the SC crisis were mentioned by the respondents, a pattern emerged with two main reasons.

5.1.1 Behavior of companies and lack of SC resilience

First, the behavior of companies led to a bullwhip effect. The bullwhip effect was mentioned by all respondents as one explanation for the SC crisis. In terms of behavior, the SC crisis is a classic example of the bullwhip effect and its consequences on the SC. When countries opened up again, the uncertainty resulted in companies ordering more than they needed according to the "*better safe than sorry*" principle, as one respondent stated. Another respondent illustrated by saying: "*you order 120% of what you think you need, and you hope you get 90%.*" The combined effect of companies acting the same way was a major bullwhip effect and system overload. Interestingly, companies acted in this selfish manner even though they knew the potential effects on the system

of ordering more than needed. One respondent called it "*hedging."* Another called it "*company hoarding."* A third called it "*hunger games.*" A fourth means that companies acted in a purely "*opportunistic manner.*" A fifth critically commented that: "*they are exploiting chances offered by immediate circumstances without reference to a general plan or moral principle.*" In addition, many companies are financially stable with excess cash. Thus, it does not hurt them financially to order more than they need. As one respondent said: *"it's a psychological effect, there is lots of money so companies can buy now."*

Second, while opportunistic behavior further amplified the crisis, companies were in fact not prepared as their SCs were not resilient. The belief system was that companies had well-functioning and resilient SCs, and that the overall system was in equilibrium. However, as the respondents stated, the reality was that these SCs were vulnerable pre-pandemic. Companies have experienced crises before in different industries or geographical regions, which have caused SC disruptions. The difference is that this crisis happened for more or less all companies in all industries in all countries at the same time. The pandemic became the perfect storm from a SC perspective and the system lost its equilibrium, and we had the SC crisis. As the respondents highlighted, in reality, the behavior and actions of companies over the last few decades had made their SCs less resilient.

Our analysis show that SC resilience did not exist, due to:

a. Low-cost focus I – leading to strategy and measurements focused on efficiency
b. Low-cost focus II – leading to internal focus, anorectic processes, too much focus on cutting costs
c. Low-cost focus III – leading to lack of SC resilience planning
d. Lack of information sharing and collaboration, and thus lack of visibility
e. Poor data management and lack of informed decision making
f. Poor cross-functional process management

In the following section, we will discuss these SC resilience aspects.

a) Low-cost focus I – leading to strategy and measurements focused on efficiency

The low-cost focus was mentioned as a key problem. From a strategic perspective, companies have focused on cost savings and efficiency improvements via for example sourcing from low-cost countries (and often with few suppliers), and inventory reductions (including safety stocks), which have made their SCs vulnerable. Similarly, from a measurement perspective, despite the discussions about customer satisfaction and balanced scorecards before the pandemic, in reality a significant pre-pandemic focus was on costs (efficiency) leading to a lack of process oriented and balanced measurement systems and consequently unprepared, not resilient, companies. One respondent said: "*In reality, the SC were vulnerable even before COVID as they were optimized for low cost and not for resilience."*

b) Low-cost focus II – leading to internal focus, anorectic processes, too much focus on cutting costs

All respondents also mentioned that the low-cost focus of companies meant a strong internal focus versus an extended SC focus. The low-cost approach, often in the form of efficiency programs such as lean and six sigma, has resulted in cost savings but, according to most respondents, the processes are now too lean. One respondent said: "*while it obviously varies between processes, very trimmed processes are not better."* Another respondent said: "*everybody is so lean today that nobody can handle a hit to the system."* In other words, the focus (e.g., goals and metrics) have been on making the internal processes efficient versus a focus on the extended SC performance and resilience. As a consequence, one could question the academic focus on the SC as the unit of analysis when in reality, the company focus is internal.

c) Low-cost focus III – leading to lack of SC resilience planning

The low-cost focus has also had negative implications related to existing SC resilience planning. In fact, many organizations had designed and implemented SCs, which in reality were not resilient. As one respondent said: "*we have been naive, we have been ignorant for risks, and we have underestimated what could happen.*" Basically, a low-cost focus leads to a system which is limited in terms of flexibility. One respondent commented that in terms of planning, it was to: "*achieve SC resilience to what I already have, it is within the existing frame, within existing processes– so I don't really have SC resilience.*" Another commented in a similar manner: "*yes we have worked with SC resilience and scenario planning, but it has been done within the parameters of an anorectic system.*" A third respondent illustrated: "*If you have chosen to source from China due to low-cost reasons, well then you are currently stuck with that option. We can do certain changes in a contingency plan but in reality the potential changes are very limited."* In other words, the existing SC resilience planning has limited options for how to handle a crisis.

d. Lack of information sharing and collaboration, and thus lack of visibility

All respondents mention that information sharing, visibility and collaboration in SCs do not really exist to the extent it is suggested in academic literature. As one respondent commented on information sharing: "*it should be this way, but it is not*" and that it will not happen as the difficulties are not just from a "how to" perspective but also from a trust perspective. Another respondent means that: "*in general, people do not understand how information sharing (or collaboration) in the extended supply chain would actually work.*" Similarly, many respondents mean that the desire for information is greater than the willingness to share information. One respondent said: "*one would like to know the real demand, but one is not equally willing (or capable) to share.*" Comparable comments were made about collaboration as illustrated in one blunt statement: *"collaboration is crap."* Obviously, without information sharing and collaboration, then visibility in the entire SCs does not exist either. Many respondents also commented on how confusing these terms actually are in reality. One respondent said that: "*terms like information sharing, collaboration and visibility sound logical and people want it, but what is it really, and how would it work?"* and another one said: *"people don't really know what it is."*

e. Poor data management and lack of informed decision making

Related, the respondents discuss the overall lack of good data and being able to handle data to make informed (and good) decisions. The respondents mentioned that it is relatively easy to collect data (despite the lack of information sharing), but more difficult and complicated to know what to

do with the data. One respondent illustrated: "*before we didn't know when a ship was about to arrive so we had to deal with it when it arrived, now we know that it may be seven days delayed, but we don't know what to do with that information."*

Others mentioned in a similar manner how companies do not do a good enough job in structuring and analyzing the data to make good decisions. The amount of collected data can lead to, as one respondent stated: "*Information overload - Hard to digest the information and with lots of uncertainty it is even harder to digest the information."* Another mentioned that with all the collected data: "*it quickly becomes complicated.*" In this perspective, the respondents also discuss how they work with aspects like business intelligence, analytics, artificial intelligence, and control towers, but not in the way they truly want to. One respondent discussed how the current control towers are not really working as well as expected as they are too retroactive in nature and he described it as a: "*retroactive tool…currently it's too much focus on history and financial results versus processes/SC"* and thus it is not a tool for good decision making. Another respondent similarly mentioned that issues with internal, departmental power conflicts when they built the control tower and how this silo phenomenon consequently resulted in a limited control tower function.

f. Poor cross-functional process management

Ironically, the focus on process efficiency has not resulted in better process management. As one respondent said: "*Process knowledge is missing."*. Similarly, another respondent commented: "*we haven't really known our processes*". Rather than good process management, improvement and awareness, the heavy focus on efficiency (process change via programs like lean and six sigma) have also resulted in a more or less artificial problem focus, according to some respondents. One respondent said: "*we have had teams searching for problems to fix so that they can report that problems have been fixed"* Another said: *"lean and black belts are focused on finding short-term problems, rather than long-term opportunities."* A third mentioned that the result of these programs is that currently: "*we are more reactive than proactive.*"

5.1.2. Conclusion on issues

The pre-pandemic approach and focus meant that the SCs in reality were not resilient. Companies were not prepared for a major crisis for many reasons, ranging from lack of long-term strategic thinking and an internal almost obsessive focus on costs, to issues with data and metrics and lack of process knowledge, awareness and ultimately process management. The behavior of companies both before and during the pandemic further amplified the crisis. Pre-pandemic, the short-term focus on costs and profits had resulted in overly lean, almost anorectic, and consequently not resilient processes and SCs. The opportunistic, borderline selfish, behavior during the pandemic created even more issues on a systems level, leading to publicly visible bullwhip effects.

Even though academia promote information sharing and collaboration in (extended) SCs, the respondents paint a different picture. There is limited, if at all, information sharing and collaboration in extended SCs and thus, visibility does not really exist either. Thus, academics may need to reconsider the Unit of Analysis in SCM. Furthermore, many companies do not have systems and procedures in place to structure and analyze collected data and to provide actionable information for decision making based on the information. Similarly, while the companies have

control towers and analytics capabilities on paper, they do not truly work as intended. This, in turn, can result in volatility in behaviors and actions and ultimately means poor SC resiliency.

5.2 Potential solutions to the current SC crisis: six pendulum shifts how companies approach SCM/SC resiliency

The potential solutions, or shifts, can be clustered into three broad categories related to strategy, data and information sharing and cross-functional process management/change management. In total, we could identify 12 suggested potential "pendulum shifts" in terms of how companies approach SCM/SC resiliency. Below we have listed these 12 pendulum shifts and in the following section, we will briefly discuss each of them.

Strategic Shift

Pendulum Shift 1: From strategy and metrics focused on efficiency to effectiveness/flexibility
Pendulum Shift 2: From single sourcing to multiple suppliers
Pendulum Shift 3: From sourcing/producing in low-cost countries to reshoring or nearshoring – capacity I
Pendulum Shift 4: From arms lengths relationships to vertical integration – capacity II
Pendulum Shift 5: From focus on inventory reduction to accepting some inventory (segments) – capacity III
Pendulum Shift 6: From focus on lean processes/lean capacity to agile flexible capacity – capacity IV

Data and Information Management
Pendulum Shift 7: From limited information sharing/collaboration to the "academic version"
Pendulum Shift 8: From limited information sharing/collaboration to vertical integration
Pendulum Shift 9: From constrained scenario/contingency planning to broader and segmented approaches
Pendulum Shift 10: From having analytics and control towers to using them for analysis and decision making (developing procedures for proactive and informed decision making)

Cross-Functional Process Management/Change Management
Pendulum Shift 11: From process efficiency/finding problems to cross-functional integration as well as process and change management
Pendulum Shift 12: From lack of process management/people focus in processes to cross-functional process management in terms of training, skills and awareness

Pendulum Shift 1: From strategy and metrics focused on efficiency to effectiveness

All respondents indicate a shift away from SCM strategies focused on efficiency (costs) to other strategies, and thus metrics, focused on effectiveness and flexibility. In many ways, it is a significant shift as both strategies and measurements drive behavior, which may lead to increased resilience as well.

Pendulum Shift 2: From single sourcing to multiple suppliers

One concrete action is a shift away from the current approach of single sourcing. The pandemic has painfully highlighted the risks and consequences of single sourcing and thus most respondents suggested using multiple suppliers. As one respondent said: "*we need more suppliers and more alternatives."* As one respondent said: "*the collaboration works best when you are tight with the supplier, but it also makes you more vulnerable (all eggs in one basket) and thus we need more suppliers.*" Another means that companies (as well as academia) have not been fully aware of the consequences of single sourcing. It has been hard to quantify costs and consequences (risks), but currently: "*we have better tools to evaluate different options and then we can also see benefits of multiple suppliers on lead times, flexibility, and resilience.*" Thus, the benefits (especially long term) justify the potential short term extra costs.

Pendulum Shift 3: From sourcing/producing in low-cost countries to reshoring or nearshoring – capacity I

Similarly, many respondents mean that companies may have to reconsider where and how they source. While outsourcing to low-cost countries have been almost the norm, this may change in the future. Several respondent mean that when focus (and thus goals and metrics) shifts away from costs to flexibility and resilience-related aspects, then it may be justified to move sourcing from low-cost countries to other places (including back to Europe or the US). Similarly, the crisis has forced companies to evaluate (reevaluate) capacity (e.g., production but also transportation etc.) as well as geographical location of capacity. For the same reasons that sourcing may be moved closer to home, the SC crisis may now justify moving production capacity closer to home.

Pendulum Shift 4: From arms lengths relationships to vertical integration - capacity II

The SC crisis may also result in increased focus on in-house capacity (e.g., production and transportation). One respondent mentioned that: "*the outsourcing trend will probably shift as it's hard to build in resilience when you outsource."* Another respondent had a similar thought: "*outsourcing has been common, but in-house makes it much more easy to control."* A key justification is increased control, which then also potentially means improved resilience. Rather than having multiple suppliers for various aspects of the business, companies will move the SC in-house instead.

Pendulum Shift 5: From focus on inventory reduction to accepting some inventory (segments) – capacity III

Related to capacity, most respondents also mean that companies need to rethink inventory capacity approaches. They discuss a needed shift away from previous focus on reducing inventories to an approach where some inventory is needed as buffers and for flexibility and how companies may have to have excess capacity for critical components. In this perspective, as several respondents emphasized, it is important to realize that not all inventory is the same and thus companies need to carefully examine needs for different types of inventory (e.g., safety stock). One respondent emphasized that inventory is more for volatility versus to increase resilience and another meant that *"increased inventories is not a long-term solution."*

Pendulum Shift 6: From focus on lean processes/lean capacity to agile flexible capacity - capacity IV

Similarly, the crisis may also justify increased production capacity (excess capacity as buffer). Some respondents mentioned that and they may have to rethink how they can ramp up capacity when needed (both machinery and labor). This also means that companies have to abandon the excessive focus on costs, which resulted in too lean and not resilient processes, in favor of more agile and flexible and ultimately more resilient processes.

Pendulum Shift 7: From limited information sharing/collaboration to the "academic version"

Information sharing is a complicated topic for the respondents. While it was mentioned as important, and while increased information sharing is desired (both from suppliers and customers), the respondents can basically be divided into two categories. The first category are the ones who still believe information sharing in SCs is possible. One respondent said that despite the current difficulties with information sharing: "*…it should ideally be this way.*" Respondents in the other camp mean, as one respondent clearly stated: "*it should be this way, but it is not*" and that it will not happen as the difficulties are not just from a "how to" perspective but also from a trust perspective. Information sharing requires trust, but trust is hard to achieve in an extended SC. Our analysis suggest that we may not see a pendulum shift in the practitioner world as the respondents mean information sharing, and collaboration in reality are limited, at least for extended SCs. While companies want information from other members of the SC, they are not as willing to share their own data/information. However, there may be a shift in academia towards a more nuanced approach to information sharing, its existence and potential benefits (ideally based on empirical evidence) in extended SCs.

Pendulum Shift 8: From limited information sharing/collaboration to vertical integration

From a company perspective, the shift may instead be towards vertical integration as it is the realistic way forward for information sharing since a company then would have control of the entire SC. In many ways, according to some respondents, vertical integration is in reality the only way an organization can manage an entire SC. Another way to look at it is as one respondent put it: "*instead of managing the supply chain, you control it."* Vertical integration would mean that information sharing would be an internal phenomenon and thus the main barriers, which currently restricts information sharing in SCs, would not exist. Tesla and Amazon were mentioned as examples of vertically integrated, and successful, companies. Although the caveat mentioned by the respondents is that vertical integration in reality only is an option for very large companies, as it requires both scale and significant financial resources. On a somewhat related note, more suppliers will further complicate the trust aspect, which would also be an argument for vertical integration.

Pendulum Shift 9: From constrained scenario/contingency planning to broader and segmented approaches

All respondents mentioned some form of the terms "external scanning, competitive intelligence and business intelligence." While companies do work with scenario and contingency planning, the respondents mean that this planning has occurred within the limits of existing criteria (e.g., within the anorectic current processes and SCs) and within the constraints of existing strategies (e.g.

outsourcing to China for low-cost reasons). Furthermore, as some respondents highlight, the scenario planning is often conducted without considering what could happen if major problems arise (e.g., a pandemic) and that, in general, the focus is often too narrow. As one respondent said: "*we have to continuously be prepared for what can happen.*" Thus, the shift means a different, broader approach to scenario planning. Companies may also need to work more with probabilities for different scenarios. They may have different scenarios for different customer/product segments, and then evaluate consequences for the different segments and scenarios. This in turn could lead to different contingency plans for different segments and ultimately different SC designs for different segments.

Pendulum Shift 10: From having analytics and control towers to using them for analysis and decision making (developing procedures for proactive and informed decision making)

While all companies collect (and to some extent share) display and analyze data and information and take actions on the analysis, there is a need for a better approach in how they work with these aspects. Related is the frequently mentioned aspect of control towers and analytics. Like external scanning, companies do have control towers and they do work with analytics, but they need to improve how they work with them. Despite the existence of Analytics, BI/AI and control towers, there is a lack of procedures for what to do with collected data, not just from an analysis perspective but also from a decision-making perspective. As one respondent said: "*we need to establish a control tower function but it needs to be a future looking tool."* The respondents mentioned how companies need better routines and procedures for how to handle and structure the data, analyze the data and make better decisions based on the data analysis. One respondent said that in order to be useful for analysis and decision making: "*the data must be better structured"* and another respondent said: *"We know BI/analytics, but we need to change into something we can use to make good decisions."* A comment from one respondent summarizes the overall perception. This respondent wants the right data/information at the right time to make good decisions, expressing this need as: "*just in time facts for decision making.*"

In short, new approaches are needed for how they collect relevant data via various sources (suppliers, customers and other external sources) but equally, if not more important is to be able to digest, structure and analyze this data and develop information for good decision making.

Pendulum Shift 11: From process efficiency/finding problems to cross-functional integration as well as process and change management

All respondents mentioned that they have to work more and better on process awareness, process management, and process improvement. Proper process management can make organizations more resilient. One respondent stated: *"if you know your processes and how people work in the processes, then you will also be better at mitigating issues"* Another respondent used the pandemic to illustrate: "*if you know and take care of your body, then you are also better prepared to deal with the virus, if you get it."* A third simply stated: "*if you know your process, things work better.*" Similarly, it is from a more cross-functional, process-oriented manner organizations should approach process improvements. As one respondent stated: "*companies should build better processes, and then continuously improve them by finding the root causes of problems…it is about*

knowing your processes and your products." Another respondent added: "*you need to know and continuously question your processes to improve them.*"

However, as they all emphasize, process (or continuous) improvement is not the same as the traditional lean or six sigma approach. While almost all companies of size have worked with various forms of change initiatives (e.g., lean and six sigma) over the last decades, the results are not very successful in terms of cross-functional process management. Companies have cut costs and improved efficiency, but the result, as many respondents said, are not necessarily better or more resilient processes. On the contrary, the focus on lean and cost cutting have has resulted in a loss of process awareness and management, and more or less anorectic processes, which, in turn, are not resilient.

Pendulum Shift 12: From lack of process management/people focus in processes to cross-functional process management in terms of training, skills and awareness

The respondents significantly emphasize the "softer" people aspect of process management. One quote illustrates what almost all respondents said about process management: "*it starts and ends with people."* For this reason, another respondent mentioned that hiring the right people was a key part of his job description. The respondents also highlight the importance of training. On respondent simply stated: "*you need to train more.*" Another respondent more specifically requested more training related to change: "*we need to increase our knowledge related to organizational change and particularly more transformative change.*" Another respondent highlighted that previous knowledge is forgotten and that: *"we have to go back to the basics and learn again, like using Deming.*" A key point here is that it is too late to conduct training when you are in a crisis. In other words, companies need to become much more proactive when it comes to training. As one respondent said: "*this is something companies should do when the sun is shining, not when the crisis hits."*

6. Conclusions and Discussion

The breakdowns of SCs during the pandemic highlight the need to reevaluate existing assumptions, not only concerning SC resiliency, but perhaps also how practice and academia approach SCM. The underlying assumption for decades is that the SC as a system can be managed, yet the illustrative examples related to strategy and visibility from the pandemic seem to indicate that the idea of a SC as the unit of analysis (UoA) should perhaps be questioned. The actual unit of analysis in companies when it comes to SCM and SC resilience is probably the organization, not the SC.

Second, as our study indicates, while government actions and consumer demand changes may have contributed to the SC crisis, the crisis was mainly a result of poor SC resilience and opportunistic behavior of companies. If nothing else, these aspects amplified the crisis. The lack of SC resilience was basically the result of a combination of factors such as low-cost strategies, internal focus and anorectic processes, lack of planning, lack of information sharing and collaboration, and poor data management. The behavior during the pandemic including aspects mentioned by the respondents as hoarding, hedging, and hunger games resulted in a classic bullwhip effect.

Third, in our analysis of solutions, the crisis may lead to shifts in focus, approach and behavior of companies, resulting in a "pendulum shift" in several SC areas, from strategy to process

management and information handling. These shifts include short-term improvements to immediate problems while long-term solutions should, ideally, address the root causes of the problems. Companies may change from single sourcing and cost focus to multiple suppliers and flexibility; from outsourcing to reshoring and in-house capacity; from reducing to increasing inventory and capacity; from lack of information sharing to vertical integration; from having data to using data in decision making; and from process efficiency to process awareness and training for change.

7. Future work

Future research can explore if and how the pendulum shifts impact existing thoughts, theories and frameworks for SCM/SC resiliency. Furthermore, since organizational memory is short, there is a fairly high probability that organizations will have a different perspective on the SC crisis five years from now. Similarly, there is a risk that the current actions are in fact over reactions as the pendulum maybe swing too far, at least for certain aspects. Future research can analyze the reactions/potential over-reactions to the crisis. In addition, this study questions some of the "accepted" academic wisdoms related to information sharing, visibility and collaboration in SCs. This is interesting as most of the academic SC literature not only promote increased information sharing, visibility, collaboration etc. but also claim that companies in an extended SC benefit from these. Our study indicates that it is more of a myth than a reality. Thus, more studies are needed to verify if information sharing and collaboration in extended SCs truly exist and what the benefits actually are. The areas of scenario planning, external environment scanning, analytics and control towers also need more research. Our study indicates that while organizations do work with these aspects, they do not work very successfully with them. Especially the aspect of routines and procedures for how to structure and analyze collected data and for decision making based on the analysis needs further research. We suggest more research related to process management and change management, especially as the previous approaches seem to have resulted in too lean and almost anorectic processes as well as a general perception that process knowledge and awareness is missing in many companies. Finally, as capacity and demand issues are at the forefront of supply chain management, we also suggest an increased focus on research related to Integrated Business Planning as tool for not only capacity and demand planning but also for cross-functional integration.

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