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Purchasing & Supply Management

Beating COVID-19 – Assessing Best Practices for Supply Chain Risk Mitigation Efforts Among US Companies

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All errors are my own.

Abstract

The COVID-19 pandemic has caused an unprecedented wave of uncertainty in global supply chains as a new pathogen has, for the first time in history, caused global supply chains to partially shut down. This qualitative study researched which risk mitigation strategies were used to mitigate supply chain risks, and which impact COVID-19 had one supply chain risks. Research found that COVID-19 further increased demand, supply, process, and environmental risks. However, the sample of ten US-based companies did not find evidence that supply risk significantly influenced financial and supply chain performance indicators. The study also did not find a difference between manufacturing and non-manufacturing firms. Moreover, the study found that all sampled companies engaged in internal collaboration as a mitigation strategy, followed by higher R&D spending. While more research is needed to fully assess the impact of COVID-19, this study lays a framework based on US companies, and a unique approach based on earnings calls.

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1. Introduction: when unprecedented supply chain disruptions challenge firm performances

1.1 The COVID-19 induced research gap

2020 marked one of the largest supply chain disruptions in modern history. One of the many examples is Tyson Foods, a leading meat producers focused on pork, poultry and beef. The company took a full-page ad in the New York Times to warn about breaking supply chains Hill (2020). The company had to shut down production due to accelerating COVID-19 cases among its employees. As a result, rising meat demand met lower production, while farmers were ready, but unable to deliver products. This ended up pushing meat prices higher and pressuring the consumer in an economic difficult time (Bloomberg, 2020). As reported by Reuters (2020), during the same period, Boeing, the world's largest aerospace producer, mentioned the importance to keep its supply chain alive as a reason to increase its debt load through borrowing according to its CEO Calhoun: "We know we are going to have to borrow more money in the next six months in order to get through this really difficult moment, to provide the right liquidity to the supply chain that represents our industry".

And not only large supply chain corporations are feeling the pain. The pressure on the consumer is visible as major retailers like JC Penny and J. Crew, as well as the auto lending corporation Hertz, have filed for bankruptcy (Pandise, 2020). Precise reasons mentioned by the author were slower consumer demand, lower entertainment spending, and stay at home orders that prohibited a lot of stores from opening.

The first wave of COVID-19 started on December 31, when the Wuhan Municipal Health Commission in China reported a cluster of cases of pneumonia in Wuhan, Hubei Province. On January 12, China publicly shared the genetic sequence of the novel virus COVID-19. Roughly two months later, on March 11, 2020, the WHO made the assessment that COVID-19 should be characterized as a pandemic, according to the WHO's official timeline (WHO, 2020). This rapid expansion was the reason for many countries to enforce lockdown measures in March. Research published after the acceleration phase of the pandemic looks at the territorial approach applied in China, Italy and the united states (Ren, 2020). Unlike China and Europe's hardest his country

Italy, the United States government left state and local authorities in charge – resulting in different forms and timelines of the so called 'shelter-in-place' orders. Between March 19, and April 2, 41 states issued these orders. The states that did not put orders in place were all governed by republicans and saw some regional urges from mayors to keep citizen as much at home as possible. All things considered, this clear difference between states almost certainly impacted supply chains differently.

The initial COVID-19 outbreak in China spurred an unprecedented wave of supply chain risk as China started to see labor shortages resulting from this outbreak. These effects were further accelerated by China's global importance, meaning not just local or regional business activities were impacted, but global markets were affected as well (Yu & Aviso, 2020). The same research also focused on the measures that led to the economic impact that followed. For example, multiple countries have imposed travel restrictions, to prevent the number of cases to grow further. Additionally, governments issued stay in place orders to limit the domestic transition of the virus. This global economic shutdown caused commodity and stock prices to fall. In the week from February 21, to February 28 alone, the world's 500 richest individuals lost $444 billion.

On top of economic damages caused by government measures, societal forces impacted the supply chains as several countries saw essential goods supply shortages, panic buying, increased usage and shortage of personal hygiene equipment as well as heightened prejudice, and cases of racism against Chinese persons in other counties in the early stages of the outbreak (Agarwal & Sunitha, 2020)

While the aforementioned findings suggest that the world is dealing with an unprecedented virus, research from April called COVID-19 a "once-in-a-century pathogen" (Gates, 2020, p. 1677). The same research placed its severity between the 1957 influenza pandemic and the 1918 influenza pandemic.

As a result, this research will focus on supply chain risks, that occurred and or accelerated during the first months of the COVID-19 pandemic and mitigation strategies used to offset risks. The setting of the research was chosen to be the United States, as this country has a large number

of large and small public companies, transparent access to media and news, and because research has not been performed in the United States with regard to the impact of COVID-19 on supply chain risks and possible best practices.

This paper will contribute to existing literature by conducting a qualitative assessment based on best practices focused on this unprecedented global pandemic. Chen, Sohal, and Prajogo (2013, p. 2186) researched the influence of supply risk, process risk, and demand risk on supply chain performance, while focusing on the mitigation strategies; supplier collaboration, internal collaboration, and customer collaboration. Their findings show a significant negative relationship between risk mitigation strategies and supply risks. This was the purpose of this research as well as the aim was to provide evidence that general supply risks and COVID-19 induced factors can be mitigated by supply risk mitigation strategies.

However, limitations were than only Australian manufacturing firms were sampled, leaving room for assessments of non-Australian firms and companies in the services/non-manufacturing sector. The case in other countries might differ as mainly the United States is home of some of the largest corporation in the world that are likely to have different methods to mitigate supply chain problems. As Lee (2019, p. 3026) stated, larger firms have an advantage over smaller firms when it comes to moderating the relationship of collaborative supply chain activities and supply chain performance due to more strategic capabilities.

Based on all aforementioned factors, the research question was chosen to be:

RQ: Which established supply chain risk strategies are used in mitigating prominent supply chain risks in times of COVID-19 among United States based manufacturing and non-manufacturing companies?

The answer to this research question will provide a novel approach and answer to the question how both manufacturing and non-manufacturing companies mitigated COVID-19 risks, and how these risks impacted these companies. Findings will deliver a valuable framework for both further scientific research and managers looking for best practices. Not only because of the

findings, but also because of the data collection method that was used. This research can be considered to be novel as the qualitative data collection searched for data in quarterly earnings transcripts. These public transcripts are freely accessible to the public and contain details explaining what happened in any given financial quarter, and why this happened. The data also includes forward-looking statement, which, despite uncertainty, can help to give readers a good overview.

2. Theoretical framework

2.1 Defining supply chain risk

In order to further assess supply chain risks, it is important to build on a basic definition of risk that has been studied frequently in the past. Baird and Thomas (1990, p. 21) defined general business risks from eight different perspectives. Their definitions incorporated organization's financial returns and the risks of bankruptcy. Shapira (1995, p. 1) found that only the minority of managers define company risks in terms of variance as a probability distribution of outcomes. Instead, managers identified risks based on the downside of risks, the magnitude of possible losses, the act of risk taking based on skills, judgement, and control, and the probability that risk is a multi-faceted construct. Table 1 shows an overview of risk characteristics and definitions based on George A. Zsidisin (2003, p. 218). Again, these risks cover basic business risks.

Table 1 Risk characteristics and definitions. Source: Zsidisin (2003), p. 218

Reference	Risk characteristics	Definition
Baird and Thomas (1990)	Variability of returns	Firm performance evaluated in terms of return and growth criteria
	Variance	Variability of the probability distribution of returns
	Market risk	The use of the capital asset pricing model to measure risk
	Risk as innovation	Risk conditions equated with conditions characterized by newness, uncertainty, and lack of information
	Risk as lack of information	Information scarcity as a key facet of uncertainty in terms of the existence of important resources and commitment duration
	Risk as entrepreneurship	Independence of action in venturing into the unknown
	Risk as disaster	Strategies that could result in corporate disaster, bankruptcy or ruin
	Accounting risk measures	Accounting ratios related to risk of ruin, default or bankruptcy
Shapira (1995)	Downside of risk	Risk being associated with a negative outcome
	Magnitude of possible losses compared to its probabilities	At least one possible outcome of an uncertain situation having a bad outcome
	Distinction between risk taking and gambling	Risk taking is associated with using skills, judgment, and control, while gambling is not
	Risk as a multi-faceted construct	Risk cannot be captured with a single number, since multiple facets such as financial, technical, marketing, production and other risk aspects exist

Risk, based on the aforementioned factors as displayed in table 1, can be regarded as a framework consisting of multiple factors. Risk is a variability of return, a variance that consists of market risk, innovation risk, and information risk. The inclusion of various risk characteristics that describe the bigger picture closely relate to earlier research. While less detailed, research from Manuj and Mentzer (2008, p. 196) defines the concept of risk based on two components. First, potential losses, meaning the size of potential losses and the significance this has on a business. Second, the likelihood of those losses, or the probability that losses occur. Based on this, it can be said that risk is the expected outcome of an event including uncertainty, where uncertainty leads to the existence or risks. These uncertain events can be called 'risk events' and potentially disrupt supply chains. This claim finds support in earlier research conducted by Yates and Stone (1992, p. 1) who notes that risk was based on three elements. First and foremost, risk needs to include the element of a loss. The second element describes the significance of a loss. The third element contains the chances the loss might occur in the first place. While these three points are a mere confirmation of the aforementioned findings, it is important to mention that Yates and Stone (1992) also mentioned additional factors within these elements. For example, risk is not limited to a specific loss. A certain loss can have a widespread impact like the destruction of multiple production areas in a certain company. The second point is that significance of a loss. It is often implied that the larger the potential loss, the higher the risk. However, this differs per company. The third point is the understanding of decision makers of loss probabilities. A lack of understanding about risk categories and the extend of losses likely skews risk models.

Moving one step lower, to supply risk, Kraljic (1983, p. 109) regarded the following risk factors: supply scarcity, the pact of technology, as well as materials substitution, entry barriers, and logistics costs. As the basic discussion of how risk should be defined has resulted in an understanding that three factors (loss, scope, and probability) drive risks, in general, the discussion of supply chain related risks is even more important. An early definition from (Meulbrook, 2000, p. 3) sees supply risk as something that "adversely affects inward flow of any type of resource to enable operations to make place; also termed as 'input risk'."

As table 2 shows, a similar definition was applied earlier. George A. Zsidisin, Panelli, and Upton (2000, p. 187) define supply risk as "the transpiration of significant and/or disappointing failure with inbound goods and services". This definition is clear as it does account

for the aforementioned factors from Yates and Stone (1992) and leaves the extend and probability of risks open to interpretation and only focusses in the fact that inbound goods and services are the key disrupter of supply chains.

Table 2 Supply risk characteristics and definitions. Source: Zsidisin (2003), p. 219

Reference	Risk characteristics	Definition
Harland et al. (2001)	Supply risk	Adversely affects inward flow of any type of resource to enable operations to take place; also termed 'input risk'
Zsidisin et al. (1999)	Supply risk	The transpiration of significant and/or disappointing failures with inbound goods and service
Mitchell (1995)	Buyer demographics	The effects of factors such as age, professional organization membership, education, and job experience on risk perceptions
	Job function	Risk perceptions differ according to the job and position of the buyer
	Decision-making unit	The greater the risk involved, the greater the propensity to group, buy and share the risk involved
	Buyer's personality	Intrinsic motivational factors exist, such as the need for certainty, self-confidence, and the need to achieve, which affect individual risk perceptions
	Buy-type	Perceived risk differs if it is considered a new buy, modified rebuy, or straight rebuy
	Product characteristics	Technical complexity and value of the item are positively correlated with the degree of perceived risk
	Degree of customer/supplier interaction	The extent of communication or state of the relationship between a buyer and supplier influences the degree of perceived risk
	Characteristics of customer/ supplier markets	The propensity to innovate, stability of the market structure, and growth rate affects risk perceptions
	Company size	The occurrence of performance risk is much higher among buyers in small companies because of the firm's limited ability to tolerate financially unfavorable decision consequences
	Organizational performance	Risk taking is affected by the relationship between the company's current position and some critical reference points
	Country	Country of origin of the buyer affects an individual's risk preference

Earlier work, but nonetheless still valid with regard to the definition of risk, is the work from Mitchell (1995, p. 115). While his research in itself supports the definition of risk, it clarifies the factors that play a role in the perception of risk based on a number of risk characteristics. For example, a large influence on risk perception comes from human factors like demographics, one's personality, and the job function one has. Moreover, the technical complexity and value of a certain item have a positive impact on perceived risk. The same goes for the propensity to innovate and stability of a market, as well as growth rates: "an obvious high-risk supply market situation would be to have numerous suppliers with a multitude of diverse products to suit one particular job and where there is a history of volatility in the market with firms regularly entering and leaving."

While most of these sources rely on research done multiple years ago, even recent studies acknowledge the validity of older studies. For example, a resilience model for cold chain logistics of perishable products based its conceptualization on risk on past studies that concluded that risk is based on the probability of loss and the consequences (Ali, Nagalingam, & Gurd,

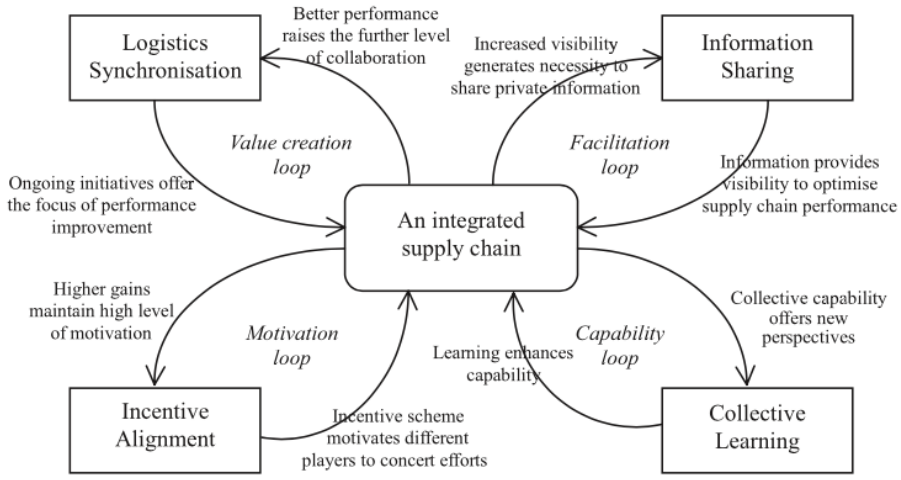
2018, p. 923). Moreover, when studying risks in the field of supply chains, the focus goes to the identification and quantification of risks.

Summarizing, it can be said that supply risk is the probability of a negative impact of uncertain extend on supply input. The extend and assessment, as well as the perception and extend of damage are dependent on factors like company and product characteristics as well as the perception of individuals. This definition makes it important to account for individual risk perception in both quantitative and qualitative research.

2.2 The development of the modern supply chain

In order to assess global supply chain risks, it is important to take a look back how supply chain's developed and turned into what seems to be a vulnerable global process in times of a global pandemic. Research from Simatupang, Wright, and Sridharan (2002, p. 298) showed that independent firms searched for mutual benefits through supply chain collaboration to withstand increasing competition due to market globalization, more product diversity, and new technological breakthroughs. While the need to achieve this was clear, research showed that it required collaborative know-how of the coordination mode, as well as the ability to synchronize independent processes, and to increasingly use and integrate information systems in order to deal with distributed learnings. As figure 1 shows, his research found four different coordination modes that drive the modern supply chain. These are logistics synchronization, information sharing, collective learning, and incentive alignment. These coordination modes are based on value creation, facilitation, capabilities and motivation. The result of these incentives is an integrated supply chain that results in higher customer service levels, lower costs, and higher sales. However, and this is what has driven supply chain risks, all of this is only possible through coordinated actions and higher collaboration level to enhance logistics.

Figure 1 The integrated supply chain. Source: Simutapang et al. (2002), p. 3001



Later, research built on this by showing the strong developments global value chains have seen, and how this has impacted global firms (Gereffi, 2014, p. 9). His research found a strong historical supply chain development through globalization and shifts in the organization and governance of global companies. In the period between the 1970s and 1980s, there was a shift through the emergence of buyer-driven and producer-driven commodity chains. In the early 2000s, this got more differentiated as global firms focused on the coordination in global value chains, as the findings by Simatupang et al. (2002, p. 3001) found as well. In the years around 2014, the global economy entered a new phase that not only altered supply chains, but also global capitalism in itself. This includes the end of the Washington Consensus and the rise of economic and political powers around the globe. It also means a combination of geographic consolidation and the value chain concentration in the global supply chain base. This development shifted bargaining power to major suppliers in developing countries in some cases. This shifts also means that new trade patterns and coordination is developing. Furthermore, the Great Financial Recession of 2008-2009 prompted a redefinition in regional geographies of investment and trade.

While the reconfiguration of global supply chains and the resulting importance of risk management has certainly been influenced by location, there is more at stake. Bhatnagar and Sohal (2005, p. 443) focused on a framework including qualitative factors concerning plant location decisions, supply chain uncertainty, and manufacturing practices to explain supply chain competitiveness. Their findings supported the case that there is a significant relationship between

qualitative plant location factors like labor, infrastructure, business environment, political stability, proximity to markets, proximity to suppliers, key competitors' location, supply chain uncertainty, broad manufacturing practices, and the operational competitive od supply chains as measured by quality, flexibility, inventory turnover, and responsiveness.

Overall, it can be said that the recent supply chain developments have increased global possibilities for companies thanks to a close cooperation, synchronization of logistics, information sharing, incentive alignment, and collective learning. Additionally, internal process connectivity, and external process connectivity have shown to have a strong positive relationship on supply chain agility (Nguyen, Huy, & Van Pham, 2020, p. 518). Their research also found that supply complexity had a negative impact on supply chain agility. Hence, further strengthening the case that modern supply chains bring forward big advantages for corporations, however, increased complexity does bring its challenges and risks. Additionally, with a shifting power structure, dependence is changing. Hence, a global pandemic is not only challenging already complex supply chains, but also emphasizing the impact increasing dependence on suppliers has.

2.3 Influencing factors on the modern supply chain

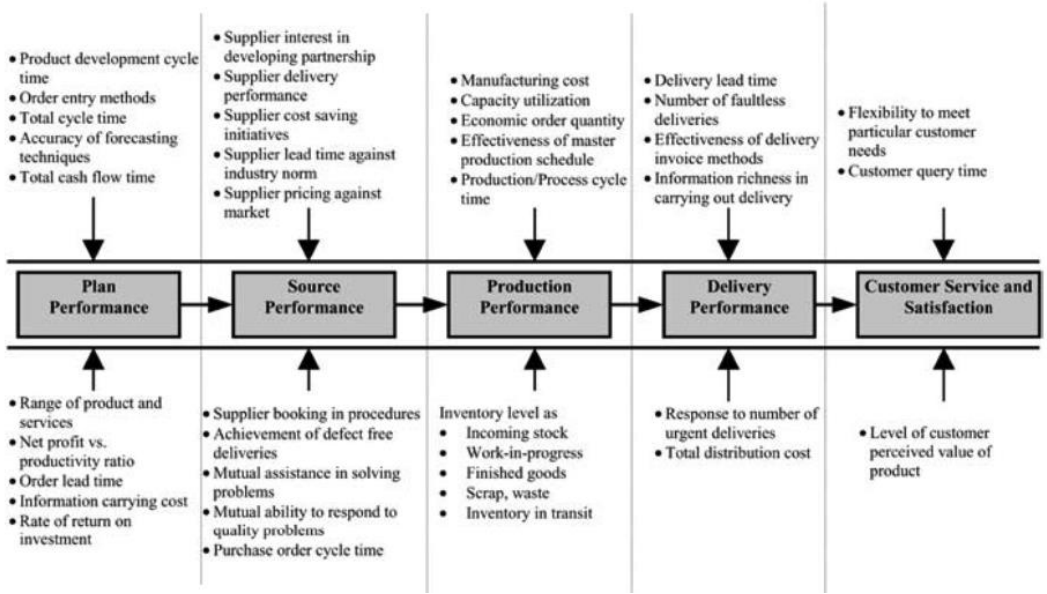
While global supply chains have become increasingly complex, it is important to maintain a focus on firm performance to assess whether a firm is making the right decisions – as simply being part of a supply chain is not necessarily a competitive advantage.

As global supply chains are a way of creating value, and not the goal in itself, a look at the prominent resource-based view as a cornerstone of competitive advantages seems to be appropriate. Peteraf (1993, p. 179) found that firms can only achieve a competitive advantage when meeting four conditions. These conditions include superior resources (heterogeneity within an industry), ex post limits to competition, imperfect resource mobility, and ex ante limits to competition. Heterogeneity implies that firms with different capabilities are able to compete in a marketplace, and at lease be able to breakeven. Firms with better resources will earn rents, which refers to earnings in excess of costs. Ex post limits to competition refers to the sustainability of rents, which means avoiding a situation where competing forces dissipate rents by increasing the supply of scarce sources. Imperfect mobility, or immobility of resources, covers the degree of ease at which resources can be traded. If resources cannot be traded or are useless outside of a

certain company, they are immobile and give companies a competitive edge. Ex ante limits to competition discuss a firm's ability to settle in an area without strong competition. A location can only be an advantage when acquired in the absence of strong competition. All factors considered, rents can be considered to be a good measurement of performance as even in a strong supply chain, competitive forces can suffer, resulting in the inability to generate profits/rents.

With regard to the aforementioned part discussing the evolution of supply chains, research has focused on the outsourcing and globalization trends and the need to asses supply chain management performance to further evolve (Gunasekaran, Patel, & Tirtiroglu, 2001, p. 71). Their research focused on establishing a list of key performance metrics for measuring the strategic, tactical, and operational level performance in a supply chain. Gunasekaran et al. (2001, p. 83) provided multiple performance metrics on three different levels: strategic, tactical, and operational to assign appropriate management levels. Additionally, they built a framework to assess the performance per stage as figure 2 shows. Moreover, each organization is responsible for its own supply chain capabilities and resources to advance timing to market of products and services at the best prices possible. This corresponds with the resource-based view and the need to stay competitive.

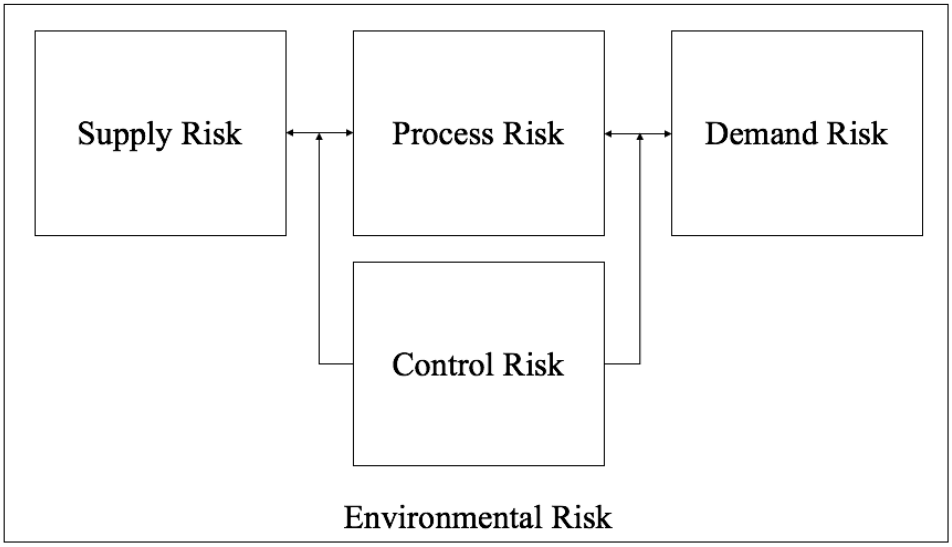
Figure 2 Measures and metrics for supply chain performance, based on planning, sourcing, assembling, and delivery. Source: Gunasekaran et al. (2001), p. 85



2.4 Exploring supply chain risk types and characteristics

Early supply chain research was triggered by uncertainty and turbulent markets, which challenged businesses as supply chain complexity increased (Christopher & Peck, 2004, p. 1). Their research focused on supply chains as resilient systems as it related to supply chains as a network. These networks are required to be adaptive in order to deal with a changing environment. As a result, resilience has been defined as "the ability of a system to return to its original state or move to a new, more desirable state after being disturbed" (Christopher & Peck, 2004, p. 2). The aim of Christopher and Peck was to assess supply chain vulnerability in the UK industry based on best practices as supply chain resilience was still a new concept in the early 2000s. As mentioned in part 2.1, supply chain risk can be viewed from different angles and perceived differently. Based upon the work of Mason-Jones and Towill (1998, p. 17), three risk categories were established, that could be divided into five categories (table 3). Figure 3 shows an overview of the five sub-categories and their relationship. Processes, in this case, are the value-adding managerial activities undertaken by the firm in order to generate value. Internally owned or managed assets are key as they support the company's assets and could lead to potential disruptions. Control assumptions, as the name already gives away, are rules and systems, as well as procedures, that show how an organization controls and monitors its processes. Control risk is a risk arising from the inability to apply rule and guidelines that support an organization's processes. Supply risk and demand risk are both risks external to the company, but internal of the supply chain. Demand risk refers to potential disturbances to the flow of products or information, and the cash flows resulting from transactions. These can also be considered to be downstream factors. Supply risk is the upstream version of demand risk as it related to the potential disturbances of flow of product or information to the company, and the cash flows resulting from transactions. The fifth risk sub-category is environmental risk. This risk type is both company- and supply chain external. Regardless, while the term external might make risk seem distant, environmental risk has the ability to directly impact firms, or their upstream and downstream operations. They can impact a particular stream of product/value or a particular relationship as shown in figure 3.

Figure 3 Sources of risk in the supply chain. Source: Christopher & Peck (2004), p. 5



Later research further emphasized the importance of the right risk indicators from a vulnerability point of view. Wagner and Neshat (2012, p. 2878) made the case that supply chain vulnerabilities cannot be observed or measured directly. As a result, Wagner (2012) built a framework based on a principal component factor analysis applied to earlier quantitative findings from Faisal, Banwet, and Shankar (2007, p. 22). His findings resulted in 10 individual single items covering supply chain vulnerability that were covered by three main drivers (table 3). In this case, supplier dependency is a cornerstone of supply side risk with customers' dependency being a lead driver od demand side risk. Similar to the findings from Christopher and Peck (2004), a risk driver covers what can be considered the environment. However, in this case, supply chain structure is characterized as a vulnerability driven by a global sourcing network, supply chain complexity, lean inventories and centralized storage of finished goods. In other words, unlike the findings from Christopher & Peck, these vulnerabilities are supply chain internal.

Kumar, Tiwari, and Babiceanu (2010, p. 3718) also defined multiple types of risk categories. In their case, they chose internal operational risks and external operational risks. Internal operational risks in this case refer to demand, production, and supply risks. In other words, they cover the upper row of the model described in figure 3. Additionally, they find the interaction risk, which is part of internal risks and is the influence of the supply chain

environment in terms of physical, social, legal, operational, and economical/political risks on the supply chain. External risks are terrorism, natural disasters, and currency risks.

Table 3 Supply chain risk types identified by researchers

Source	Risk categories	Characteristics
Christopher and Peck (2004)	Firm - internal	Process and control risks
	Firm - external, but supply chain internal	Demand and supply risks
	External to network	Environmental risks
Kumar, Tiwari, and Bibiceanu (2010)	Internal operational risks	Demand, production, and supply risks
	External operational risks	Terrorism, natural dissasters, currency risk
Lin and Zou (2011)	External environment	
	Risk within supply chain	
	Internal risk	
Tang and Musa (2011)	Meterial flow	
	Financial flow	
	Information flow	
Wagner et al. (2012)	Demand side	
	Supply side	
	Supply chain structure	

Lin and Zhou (2011, p. 164) looked at supply chain risks from a multi-dimensional point of view based on the findings of Waters (2011, p. 1). They found three main categories: internal risks, external environment, and risks within the supply chain. Internal risks cover operations within the company like planning, R&D, production, information and the organizational structure itself. External risks cover policy, supply, delivery whereas supply chain risks cover the macro environment and risks impacting the supply chain. In other words, both external risks and risks within supply chain risks are outside risks impacting firms.

Tang and Nurmaya Musa (2011, p. 25) looked at supply chain risks from a different angle as they assessed risks that would apply regardless how simple or extended a given supply chain is or is perceived to be. Their research saw three key risk elements, namely material flow, financial flow, and information flow. Material flow covers supply issues like sourcing risks, supply capacities, make-or-order decisions, as well as logistics. Financial risks refer to exchange rate risks, price and cost risks, as well as financial strength of supply chain partners. Information flow risk covers value adding activities like demand, inventory status, order fulfillment, product and process design changes. It can be seen as the bonding agent between material flow and financial flow. Moreover, (Sreedevi & Saranga, 2017, p. 338) found a significant negative relationship between environmental uncertainty and supply, manufacturing, and delivery risk.

Summarizing, the recent research from Parast (2020, p. 4) summarized disruption risks appropriately as it used both internal and external risks, and incorporated the company's own

capabilities through process risk, supply chain inflow and outflow through demand and supply risks and external risks on the supply chain through environmental risks. While many studies in the past found multiple ways to assess risks, these are the ones that seem to be most appropriate as they incorporate all aspects impacting a supply chain.

2.5 The COVID-19 impact on risks categories

As discussed on part 2.4, modern supply chain risk research focuses on a number of risk categories (figure 3). These risk categories cover a wide variety of possible outcomes. With this in mind, and with the aim to research the impact of COVID-19, one could make the case that the world is simply dealing with an environmental risk issue as Parast (2020, p. 12) quantified environmental risk by looking at political instability, international terror attacks, disease or epidemics, natural disasters, changes in the political environment, and administrative barriers. Ivanov and Das (2020, p. 98) suggested that traditional supply chain risk practices simply do not apply anymore in a situation like the 2020 COVID-19 pandemic as they argue that proactive measures like inventory hoarding do only help at the beginning of a pandemic because one main variable is often underestimated: the length of the pandemic.

Rizou, Galanakis, Aldawoud, and Galanakis (2020, p. 295) found that COVID-19 an advanced virus as it capable of infecting humans and animals and was detected in sewage samples of different cities in the Netherlands and Spain. According to them, the virus may be inactivated significantly faster than non-enveloped human enteric viruses with a well-researched waterborne transmission. As a result, it impacts the way humanity arranges its lives as it impacts everything ranging from seating arrangements in schools, restaurants, and safety measures in every single step of global supply chain.

Interestingly, research from Paul and Chowdhury (2020b, p. 285) shows that just recently the need for an additional risk category was needed. Their research found two core risk categories, namely, operational and disruption risks. The characterization was based on the predictability of risks where disruption risks are often catastrophic events. However, in light of the recent COVID-19 outbreak, research warranted a third category; extraordinary risks. While these risks can be perceived to be somewhat similar to disruption risks, the key difference is that they are characterized by a long-term existence of the risk impacts, a high uncertainty of the future impacts, and the ripple effect of the event on other functions or processes. Paul and

Chowdhury (2020a, p. 1) mentioned another factor playing a role. In this case, extraordinary risk events have simultaneous impacts on sourcing, production, and demand management. Additionally, these impacts are different for various types of products like high-demand and essential items, regular items, and fashion products. This requires an extra adaptive strategy according to their research and confirms prior findings that warrant to give COVID-19 risks special treatment beyond the 'traditional' disruption risks that include pandemics.

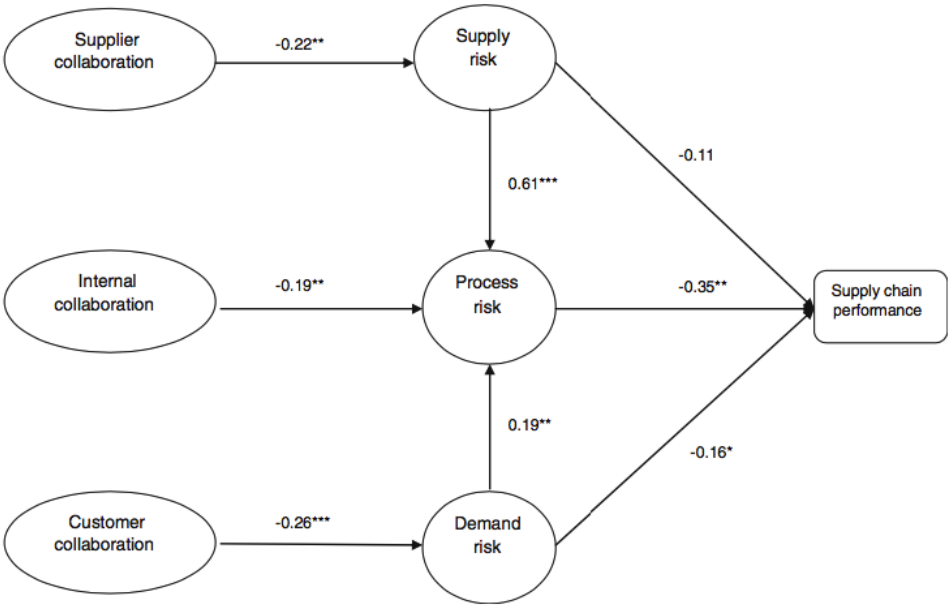
2.6 Analyzing supply chain risk mitigation strategies

In light of the aforementioned risk categories and the special case COVID-19 has turned into, it is important to reflect on the most prominent supply chain risk mitigation strategies and their use in different scenarios.

Just like with the assessment of supply chain risks, mitigation strategies have been researched in the past and multiple, often completely different, findings have been presented. As risk mitigation strategies are a part of the broad term 'risk management', the definition as proposed by Bannister and Bawcutt (1981, p. 1) applies as they see risk management as "the identification, measurement, and economic control of risks that threaten the assets and earnings of a business or other enterprise."

Influential research on the influence of collaboration of supply chain risk focused on supply chain collaboration as a risk mitigation strategy (Chen et al., 2013, p. 2186). Their research examined three types of risk. These risks were supply risk, demand risk, and process risk. The three collaboration types chosen were supplier, customer, and internal collaboration. Based on 203 Australian firms, the results showed each collaboration strategy effectively mitigated supply chain risk (figure 4). Figure 4 shows that supplier collaboration significantly lowers supply risk. Internal collaboration significantly lowers process risk, and customer collaboration significantly lowers demand risk. Interestingly enough, in this model, supply risk does not significantly impact supply chain performance in a negative way.

Figure 4 The influence of collaboration strategies on supply chain risks. Source: Chen et al. (2013), p. 2194



As table 4 suggest, most articles researching risk mitigation strategies found collaboration to be an effective way of reducing risk. For example, earlier research from Braunscheidel and Suresh (2009, p. 133) found the integration of suppliers, customers, and internal capabilities as a measure to enhance supply chain agility. Their research found that firms with a strong integration of both customers and suppliers, had a better performance of agility, and therefore risk mitigation as a response to disruptions. Internal integration was the third major antecedent for agility, and therefore risk mitigation and response.

Table 4 Supply chain risk mitigation strategies identified by researchers

Source	Risk mitigation strategy
Chen, Sohal, and Prajogo (2013)	Supplier collaboration Internal collaboration Customer collaboration
Braunscheidel and Suresh (2009)	Internal integration External integration with key suppliers External integration with key customers Volume flexibility Mix flexibility
Zsidisin and Smith (2005)	Early supplier involvement
Zsidisin et al. (2008)	Supplier relationships Early supplier involvement Direct supplier development
Parast (2020)	R&D spending

Similar to collaboration strategies, George A. Zsidisin and Smith (2005, p. 44) focused on the impact of early supplier involvement as a tool to mitigate supply disruptions and other negative supply events. In this case, their research focused on an aerospace supplier. The benefits from early supplier integration included cost reduction, and margin enhancement, lower pressure from legal liabilities are intellectual property rights were established earlier on. Earlier alignment also allowed to avoid quality problems and supplier capacity constraints, as well as supplier organization leadership issues. While this is a lot, these measures particularly aim to reduce product design and supplier performance risks.

Later work from George A Zsidisin, Wagner, Melnyk, Ragatz, and Burns (2008, p. 401) looked at supply disruptions stemming from tragedies like the September 11 terror attacks and the Hurricanes Rita and Katrina. Based on the analysis of both United States and German companies, George A Zsidisin et al. (2008, p. 415) found that companies focused on goal congruency and a reduction in information asymmetries between purchasing firms and suppliers. This includes all risk mitigation strategies as described in table 4 as companies not only worked together with suppliers from an earlier stage, but also started involvement earlier and allowed direct supplier development. Normally, these practices focus on reducing the probability of risk happening in the first place, and not only to mitigate the impact of occurring risks (George A. Zsidisin & Ellram, 2003, p. 15).

Besides that, research focused on external factors like the aforementioned supplier and customer relationships, research also focused on firm internal factors like R&D investment levels. Parast (2020, p. 4) used R&D spending as a measure of a firm's investment in innovation. As higher R&D spending is associated with a higher innovative capability, R&D spending was found to have a risk mitigation ability and could linger the impact from supply chain disruptions. However, like prior findings (table 4), supply chain collaboration as a risk mitigation was required to be key as supply chain disruptions had a wide reach than just a single firm in the event of a disruption.

Overall, research conducted over the past fifteen years shows that collaboration is deemed as an effective method to mitigate supply chain risk. In this case, collaboration covers the entire supply chain as both external collaboration through customer engagement and supplier innovation are positively effecting risk mitigation. In addition to that, internal integration was found to be a driver of supply chain agility as well.

Based on this context, it is important to define collaboration mitigation strategies. Collaboration exists in many forms (table 5). Overall, collaboration rely on communication strategies, whether it is to involve suppliers in product development or interact with customers better.

Table 5 Collaboration mitigation strategies and descriptions. Based on Chen et al. (2013), p. 2193

Risk mitigation strategy	Description
Supplier collaboration	Helping suppliers to improve product quality
	Solving problems jointly with suppliers
	Continuous improvement plans with supplier
	Including suppliers in planning and goal-setting
	Involving suppliers in new product development
Internal collaboration	Using cross-functional teams to solve problems
	Frequent communication with senior management
	Routine meetings across departments
	Face-to-face meetings to solve problems
	Encouraging openness and teamwork
Customer collaboration	Committed to customer relationships
	Willingness to make adjustments to support relationships
	Maintaining interactive, two-way communications with customers
	Cooperation with customers to ensure smooth operations
	Solving problems jointly with customers

Summarizing, research shows that supply chain risks are mitigated by a number of strategies. These are various collaboration strategies aimed at suppliers, customers, or internal factors. Additionally, research has found that increased research and development spending has proven to mitigate risks due to a higher innovative capability. On top of that, early supplier integration has been found to have a risk-mitigating ability as it enhances margins and avoids capacity constraints in a lot of cases.

2.7 Manufacturing and non-manufacturing firms have significant differences when it comes to supply chain risk management capabilities

As aforementioned, most supply chain risk research has been conducted in manufacturing industries. However, as the aim of this research was to test both manufacturing and non-manufacturing firms, it is important to take a look at factors that might or might not explain differences between manufacturing and non-manufacturing firms. According to Ellram, Tate, and Billington (2004, p. 17) there are significant differences with regard to business expectations, quality, demand predictability, cost, contract completion and payments when

assessing manufacturing and service firms. Especially with regard to demand predictability, the focus is on project scope for service companies whereas manufacturing firms are mainly dependent on per unit orders. Reed and Storrud-Barnes (2009, p. 319) found that the characteristics of goods and services, and their effects on the drivers of firm performance vary according to the tangibility of goods and services, and the customization of goods and services. They also found that the more goods and services become intertwined, the more customers become involved, and the more products are designed to service customer needs. Even more importantly, manufacturing firms are often more able to establish economies of scale, allowing them to cope better with risks.

Table 6 Core differences between manufacturing and non-manufacturing firms

Source	Core manufacturing & non-manufacturing differences
Ellram, Tate and Billington (2004)	Demand predictability as manufacuring firms depend on per-unit orders
Reed and Storrud-Barnes (2009)	Manufacturing firms are able to generate higher efficiencies by establishing economies of scale
George A. Zsidisin and Ellram (2003)	Manufacturing firms are significantly more likely to apply behavior-based risk management techniques as a result of perceived risk
Ehie and Olibe (2010)	Manufacturing firms produce tangible products, hence they apply different research and development approaches.
Dias et al. (2020)	Manufacturing firms have a significantly higher allocative efficiency

With regard to risk mitigation, George A. Zsidisin and Ellram (2003) found that firms in the manufacturing sector are significantly more likely to apply behavior-based risk management techniques as a result of perceived risk than non-manufacturing firms. Ehie and Olibe (2010, p. 129) finds that services and manufacturing firms apply very different research and development investment approaches. Manufacturing firms produce tangible products that are distinguishable and interchangeable. Service firms often engage in intangible, almost always perishable business interactions.

Other research found that resource allocation is also vastly different. The level of allocative efficiency among service companies is significantly lower than the allocation efficiency of manufacturing firms (Dias, Robalo Marques, & Richmond, 2020, p. 390). Based on regression

analysis, the study found that the difference was based on productivity shocks, which capture the impact of both capital and labor adjustments and/or the price rigidity. The service sector is prone to higher inefficiencies due to its higher output price rigidity and higher labor adjusted costs.

Overall, it can be said that manufacturing and service companies are expected to behave differently under certain circumstances as both sectors produce different products, have supply chain differences, and see significant differences in resource allocation efficiencies.

2.8 Assessing supply chain performance

As risks are a factor potentially preventing firms and individuals from reaching their desired performances, it is important to establish a definition of firm performance in a supply chain. (Beamon Benita, 1999, p. 275) focused on supply chain performance and goal measurement as soon as global supply chains started to become more complex. Basically, what was found, was the importance to measure a combination of cost and customer responsiveness as this, historically speaking, covered most aspects of the supply chain. However, the same research found the importance to focus on the use of resources, the desired output, and the flexibility. Especially the part of flexibility was needed to measure resilience in times of uncertainty. As table 7 displays, Beamon (1999) focused on resources, output and flexibility. This is similar to later research conducted by Chen et al. (2013, p. 2193) who mainly focused on output through product quality, delivery dependability, and customer satisfaction variables.

Table 7 Supply chain performance measure types

Source	Performance measure type
Beamon (1999)	Resources
	Output
	Flexibility
Chen et al. (2013)	Product quality
	Order fill capacity
	Delivery dependability
	Delivery speed
	Customer satisfaction
Parast (2020)	Return on assets
	Overall product quality
	Overall customer service levels
	Drop in market share
	Drop in average selling price
	Drop in overall competitive position

Parast (2020, p. 12) focused on output and efficiency variables as well as he looked at the return on assets, overall product quality, customer service levels, market share, average selling prices, and competitive position.

Arzu Akyuz and Erman Erkan (2010, p. 5151) found that performance measurements shifted over the years from a cost/efficiency focus to a focus on value creation and a stronger focus on the client, instead of profits. This includes that comparison levels are not 'standard' values, but constant improvement rates. Additionally, they found that an aim on evaluation and involvement stimulated innovation and performance more than regular evaluations based on established criteria.

For the purpose of this research, the choice was made to focus on output and efficiencies as a successful output and high efficiency say a lot about input while incorporating product quality, and customer satisfaction.

3. Propositions

Based on the literature framework, in this section, the propositions of this research will be discussed. This section includes a clear framework of propositions, detailed explanation and an overview displaying all proposals and relationships. Chapter 4 discusses the research approach and methodology, followed by an analysis of the results in chapter 5.

3.1 Supply chain risks, accelerated by COVID-19, negatively impact performance indicators

Given an ever-rising dependence on smooth and modern supply chains, it is assumed that supply chain risks have a negative influence on performance measures. The risk types used in this research are supply risk, process risk, demand risk, control risk, and environmental risk (Christopher & Peck, 2004, p. 5). In addition to that, the novel Coronavirus is expected to play an additional role besides the researched environmental risks, as it is assumed that the traditional way of dealing with this virus does not apply anymore (Ivanov & Das, 2020, p. 98). As a result, it is expected that the aforementioned five risk categories are accelerated by COVID-19, giving it

a moderating effect. Also, because COVID-19 is a novel virus, the choice was made to incorporate all risk categories instead of only environmental risk, which is more likely to be negative impacted as it includes pandemics.

Based on the risk assessment, the next step needed to answer the research question is to find the impact on performance. According to findings from Chen et al. (2013, p. 2194) process and demand risk have a significant negative influence on supply chain performance. However, as his research focused mainly on 'outgoing' quality measures like product quality and customer satisfaction the decision was made to include supply risk and environmental risk as well. Additionally, the choice was made to focus on more than just output variables and include efficiency measures as well as a performance indicator. The reason to include both output variables and efficiency variables, is because they complement each other in studying firm performance. While firm performance studies vary, a lot of studies incorporating both firm strategies and performance measures look at efficiency ratios like the return on assets as well as output measures like sales growth (White Gunby, 2009, p. 812). If COVID-19 is indeed accelerating supply chain risks, it should be expected that asset utilization drops because of lower incoming sales and/or difficulties procuring the right materials. This will likely hit return indicators, margins as well as sales growth in addition to supply chain measures measuring delivery speed, customer satisfaction, dependability, and order fill capacity. The choice was made to look at both financial performance and supply chain performance as supply chain performance could have a lasting negative impact on the company as supply chain performance measures need to have a sustainable long-term focus (Arzu Akyuz & Erman Erkan, 2010, p. 5151). While it is hard to measure the supply chain performance, the choice was made to look at both input and output from firms, which shows whether they were able to get the needed supplies in order to satisfy demand. For example, if in an economic setting firms do not run into trouble when it comes to satisfying demand and acquiring input (commodities), one can conclude that supply chains are efficient.

Hence, the first proposition is formulated as:

Proposition 1: COVID-19 has increased the negative impact from supply, process, demand, control, and environmental risk, resulting in a significant negative impact on both supply chain and financial indicators.

3.2 Risk mitigation strategy as a moderating force on the supply chain risk impact

While the first proposition focusses on the negative impact from COVID-19 on supply chain risk indicators and performance measures, the next step is to focus on the mitigation impact from supply chain risk strategies. Based on the theoretical framework discussed in chapter 2.6, the choice was made to focus on collaboration strategies, early supplier involvement, and R&D spending. However, because the aim of this research is to find best practices, these will only be used as guidelines as it is believed that strategies along these lines might have been used, and, as a result, might have mitigated supply chain risks. Based on this, it is assumed that best practices applied by firms will fall into the aforementioned categories, and that these measures are believed to have mitigated risks significantly in a way that further potential performance losses have been avoided. As table 8 shows, mitigation strategies used in this research are expected to mitigate all discussed risk types and positively influence both output performance indicators and efficiency indicators.

Table 8 Proposed mitigation strategies and expected influence on risks/performance indicators

Mitigation strategies	Expected influence on risks/company performance
Collaboration strategies	
Supplier collaboration	Significantly mitigates supply risk, but does not directly impact supply chain performance
Internal collaboration	Significantly mitigates process risk and supply chain risk. Also, mitigates supply risk impact on supply chain performance
Customer collaboration	Significantly mitigates demand risk, and enhances supply chain performance
Early supplier involvement	Mitigates risk through cost reduction, margin enhancement, lower pressure from legal liabilities. Hence, mainly supporting efficiency performance indicators
Research & development	Higher R&D spending supports firm performance and supply chain performanc e(both output and efficiency indicators) agains demand, supply, process, and environmental risks

Hence, based on historical research and the unique COVID-19 situation, it is expected that these mitigation strategies have played, and to some extend still play, an extensive role in company's risk management approach.

Therefore, the second proposition is:

Proposition 2: supplier collaboration, internal collaboration, customer collaboration, higher R&D spending, and early supplier involvement play a significant role in company's best practice to mitigate supply chain risks.

3.3 Manufacturing & non-manufacturing companies show significant differences in their risk mitigation efforts

As most supply chain research has been conducted among manufacturing firms, this research papers includes both manufacturing and non-manufacturing firms when assessing risk mitigation strategies in an unprecedented economic period. As aforementioned findings from (Ellram et al., 2004);(Reed & Storrud-Barnes, 2009);(George A. Zsidisin & Ellram, 2003);(Ehie & Olibe, 2010);(Dias et al., 2020) show, manufacturing and non-manufacturing have significant differences with regard to demand predictability, efficiencies based on economies of scale, the application of behavior-based risk management techniques, the differences between tangible and intangible products, and the higher allocative efficiencies from manufacturing firms.
The purpose of this paper is to look at companies in both categories to identify if differences can indeed be spotted. Linton (2019, p. 1) found five key differences that influence the profitability of a company. These are, in no particular order, the tangibility of output, production on demand, customer specific production, labor requirements and automated processes, and physical production locations. In more detail, this means that manufacturing firms have to deal with inventory management in a way that service firms simply don't have to. This emphasizes supply risk. On the other hand, demand risk is also impacted differently as service firms 'produce' on demand, meaning that manufacturing firms need to manage outgoing inventories differently. Additionally, manufacturing firms are in general less dependent on labor and able to automate processes. This means that process risks are likely perceived differently. With regard to the physical location of production, manufacturing firms are more than likely unable to quickly

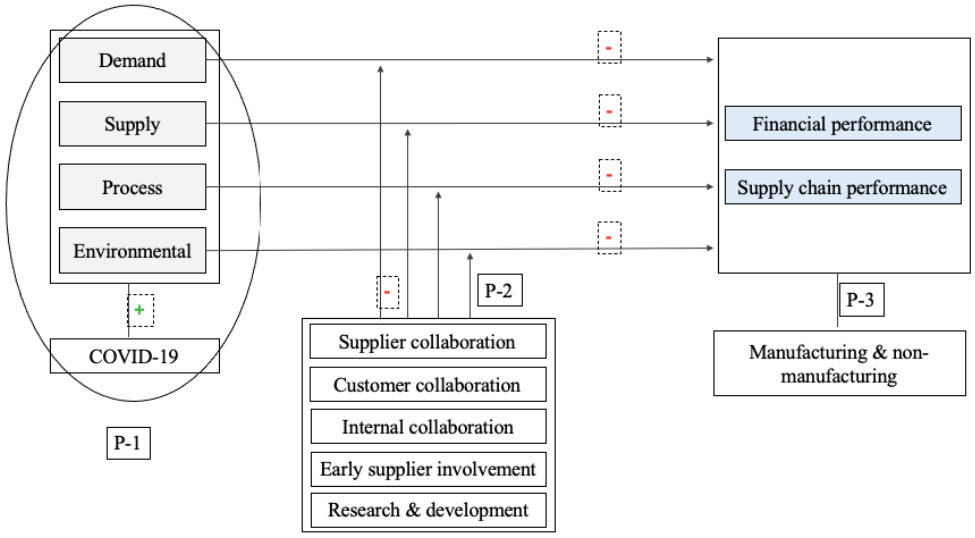
change production location as they are less flexible, hence exposing them to increased environmental risks (i.e., local weather or pandemic conditions).

Hence, the third proposition is:

Proposition 3: Manufacturing and non-manufacturing firms will report significant differences with regard to applied mitigation strategies as both sectors will likely be differently influenced with regard to demand, supply, process, and environmental risks.

All propositions and research variables are included and displayed in figure 5. As aforementioned, the circle shows the expected influence of COVID-19 on risk factors and the expected impact on performance indicators.

Figure 5 Research model, including 4 propositions



4. Methodology

4.1 Best practices research

This research is based on a deductive research approach aimed to find a confirmation based on an observation after a theoretical framework and propositions have been established. Best practices research will reveal practices that have either been described by theoretical frameworks

in the past or show entirely new findings that might help companies in the future to mitigate risks. However, in order to gain the best findings, it is important to established guidelines that make a comparison and data analysis easier. For the purpose of conducting a structured best practices research, the used approach has been based on guidelines established by Eglene (2000, p. 2). These guidelines focus on using clear proposals based on the main research question(s). In this case, the propositions will be used for suitable fundamental background before the earnings call transcripts are being analyzed.

The best practice methods has been based on earlier research from Bretschneider (2004, p. 307) who looked at best practices as a tool to do substantial research. His research found a number of conditions that had to be satisfied in order for a something to be a 'best practice'. His three conditions were a comparative process, an action, and a linkage between the action and some form of outcome or goal. An example used in his research was a comparison between several organizations and the success of their strategic planning initiatives. While the definition seemed to be simplistic, there are multiple issues that arise when conducting such research. For example, comparability is key for the identification process and the context. In other words, are companies across multiple segments even comparable? There needs to be common ground between companies. The third point, after having defined clear actions, linkage between actions, aims to create an understanding of cause-and-effect relationships. This is why this paper makes use of a clear research model and well-defined variables that guided the interviews with the company representatives. Furthermore, to be sufficient, the selected cases for comparison must all include comparable cases for a relevant domain. Otherwise, it is not possible to establish a best case in a series of best cases. While completeness of cases and comparability are key, it is of utmost important to include as many cases as possible to establish a comparison. Best practices research focused on health promotion practices showed the importance of the aforementioned criteria (Green, 2001, p. 165). His research established research gaps based on prior theoretical knowledge. He wanted his best practices to be more than trial-and-error outcomes and 'fuzzy' systems research with variables that are not clearly linked from previous research from, in his case, health outcomes. He also wanted to avoid investigator-centered studies in unrepresentative populations. This is why this study is based on a wide variety of industries and companies with a large (global) footprint that, also with support from their suppliers, represent a large economic force.

As a result of all discussed factors, and as aforementioned, the choice was made to focus on earnings transcripts only. These are unbiased as they are presented to a large audience consisting mainly of analysts and investors, and because this made it possible to analyze multiple companies in a short period of time.

4.2 The earnings call analysis

The choice to base this research on earnings call transcript was somewhat unique as there has never been significant supply chain research been published based on earning call transcripts. The reason is likely that earnings call transcripts are a way to communicate with shareholders and include more info besides comments regarding supply chains. Other options that were in consideration are face-to-face interviews with supply managers. The benefits of this would be more direct and customized answers to supply chain-related questions. However, the downside turned out to be that supply managers were often too busy during the 2020 pandemic to respond to requests, which caused the response rate to drop to nearly zero. Another options that was considered was a survey. Surveys are a great way to collect data in larger quantities as it allows subjects to fill in surveys in a time-efficient manner. However, as the goal was to find out detailed information about best practices, it was deemed insufficient to send out surveys that were likely to miss the point as every company was expected to have different best practices. This would have resulted in surveys with long, and detailed open questions. Hence, the choice was made to replace human interaction and questionnaire surveys with earnings calls.

The earnings call transcript analysis was based on interview questions who are based on findings from Gugiu and Rodríguez-Campos (2007, p. 339). Their research focused on semi-structured interviews for logic models and included the need to generate basic contextual background, in this case a theoretical framework, before analyzing proposals. The choice was made to base the analysis on these questions as the questions incorporate a full theoretical framework and can be used in future research for extended qualitative research. In other words, the questions were used to scan the earnings transcripts for useful information. Additionally, the questions were originally made to conduct face-to-face interviews with purchasing and supply chain managers from various companies. However, as plans changed due to the COVID-19

situation, the choice was made to only focus on earnings transcripts, but to still use these questions as they were fully based on the theoretical framework and would guide the analysis of these transcripts (appendix B).
The questions consist of a few set blocks based on the propositions explained in chapter 3. All main questions are then supported by a number of sub-questions containing detailed information based on the theoretical framework and research aim. This has been done to make sure that all theoretical discussion points have been incorporated. Another purpose of keeping these questions in the research report, is to guide future research as it gives more details regarding the approach of the research conducted in this paper. Appendix A shows an overview that was part of the theoretical framework, used to track the completeness of the questions.

As the interview questions show, questions regarding financial performance were not included as these will be retrieved prior to the analysis of the transcripts. Questions regarding manufacturing and non-manufacturing differences were also not included as answers to the existing questions delivered enough data to make a clear distinction between these two segments based on theoretical frameworks.

Note that the choice was made to mainly include companies that reported higher than expected earnings per share in the second quarter of the 2020 calendar year. This would make it more likely that companies with efficient best practices had been included.

The earnings calls used cover the period between March and October of 2020 through the second and third fiscal quarter to make sure that the company comments on the full impact of COVID-19. It also erases the impact from companies operating on different fiscal years. While the breakdown of these transcripts was not influenced by this research, they revealed enough information to answer the propositions.
Additionally, the fact that analysts are able to ask questions makes transcripts a good alternative to interviews as questions include a wide variety of topics to support financial modelling, including risk factors, expectations, and strategies. Another important point worth mentioning is that all transcripts are freely accessible on various financial websites and is some cases the websites of stock listed companies.

The following companies were used in this research paper. Note that the companies with the number 1, 3, 4, and 7 are considered either service companies or companies with a focus on service within the manufacturing industry.

1. Armstrong Flooring – Building Products & Equipment
2. GrafTech International – Electrical Equipment & Parts
3. Steven Madden – Footwear & Accessories
4. The Andersons – Food Distribution
5. Sealed Air – Packaging & Containers
6. Tenneco – Auto Parts
7. AAR Corp. – Aerospace & Defense
8. Valero Energy – Oil & Gas Refining & Marketing
9. Terex Corp. – Farm & Heavy Construction Machinery
10. Alcoa Corp. – Aluminum

5. Results

This part discusses the results from the interviews and the earnings call transcripts. Per section, one American firm is discussed, which includes finding the impact of COVID-19 on the performance and a discussion of mitigation strategies. All findings are based on the questions that were prepared in advance as this is applicable to both public transcripts and one-on-one interviews. At the end of this chapter, a summary and discussion of the three propositions is given. Where appropriate, the page number of the transcripts has been mentioned. Note that the quarters cover fiscal years. While fiscal years differ, the data always covers the second calendar year quarter of 2020, which saw the largest impact of COVID-19 due to government mandated shutdowns.

5.1.1 Armstrong Flooring – A cyclical housing and global supply chain player

These findings are based on the company's Q2/20 and Q3/20 earnings call transcripts.

Company details: Armstrong Flooring is a Delaware corporation incorporated in 2015. The company is a leading global producer of resilient flooring products for use primarily in the construction and renovation of commercial, residential, and institutional buildings. Armstrong Flooring designs, manufactures, sources and sells flooring products primarily in North America and the Pacific Rim. The company sells 80% of its products in North America. 45% of total sales are made in North American commercial industries. 70% of worldwide sales were generated in renovation projects.

Its customers are mainly independent wholesale flooring distributors, who re-sell Armstrong's products to retailers, builders, contractors, installers, and others. In the commercial sector, the company has business relationships with subcontractors' alliances, large architect and design firms, and major facility owners in focus segments. In 2019, 80% of sales were to distributors.

Development of company performance during crisis: In the second and third quarter of 2020, the company reported sales contraction of 18.1% and 5.4%, respectively. The company's operating margins fell to -8.0% in Q2 and -6.4% in Q3.

Strategies taken: Armstrong Flooring is a good example of a company that first saw a negative impact from the Coronavirus but later benefited from it. According to President and CEO Michel Vermette, the company benefited from a strong surge in residential construction as families were moving to the suburbs. This was partially offset by decreasing demand in commercial building activities as commercial activities were slowed by the virus. This caused higher demand volatility as a direct result of the COVID-19 lockdowns and the secular trend that followed and boosted residential demand (Q2; p. 2).

In the second quarter, the company had trouble getting product to end-customers as distribution customers were suffering from shelter-in-place orders. This hurt delivery dependability. However, the company did not run into supply issues as the company had implemented a leaner supply chain operation ahead of the unexpected pandemic (Q2; p. 4).

As a result, the company implemented multiple measures to counter risks. For example, the company started a roadmap to transform and modernize its operations to become leaner, faster growing, and more profitable. This includes a number of measures. For example, the company will transform its product portfolio by reengaging with customers, reintroducing innovative products, and rebalancing its residential and commercial footprint. The company aims to engage with customers more effectively and shift to virtual interaction, which has not negatively impacted the company (Q2; p. 4).

5.1.2 GrafTech International – A leading steel supply chain company

These findings are based on the company's Q2/20 earnings call transcript

Company details: GrafTech was founded in 1886 as the National Carbon Company, which was then acquired by Union Carbide in 1917 and became its Carbon Products Division. In 1995, the company became a public company, after which management decided to acquire a number of companies like Seadrift Coke, a manufacturer of petroleum coke, which is an essential component in the production of graphite electrodes. During all these years, the company established itself as a leading manufacturer of graphite electrodes and petroleum coke, which are both essential for the production of electric arc furnace steel.

Development of company performance during crisis: The company, which changed its name to GrafTech in 2002, has a very concentrated ownership structure as 73.9% of outstanding shares are held by Brookfield Asset Management Inc.

In 2015, Brookfield acquired the company for $1.25 billion as the company was struggling with poor earnings and was facing a severe downturn in the steel industry. Brookfield focused on the company's strengths like the aforementioned acquisition of Seadrift Coke. This transition included the divestiture of non-core assets and a renewed focus on the electrodes business. As a result, the company now produces more from three plants than was previously produced from six plants. In 2018, the company went public again and now operates plants that are among the world's highest-capacity production facilities.

With regard to the regional revenue breakdown, the company generated 48% of its 2019 sales in EMEA countries, 42% in the Americas, and only 10% in APAC countries.
In the second quarter, the company saw a steep decline in its utilization rate as it dropped to 65%. The company suffered from significantly lower demand due to lower steel production. Global (ex-China) steel demand declined by 25%. GrafTech also saw lower prices, which means that both lower volumes and worse pricing hit total sales. As a result, total sales declined by 41.6% in the second quarter. Operating income dropped by 50.1% as operating margins declined to 47.5%.

Strategies taken: To combat the impact of the virus, GrafTech took significant steps to protect employees, leading to a recordable injury rate decline of 56%. Measures included ways to include more machinery in human interactions, and hands-off practices. GrafTech also implemented created COVID-19 response teams that meet 3 times per week to assess the situation at all locations. The company also restricted non-essential travel and increased PP&E equipment as well as mandatory testing P. 3).
While production levels have fallen, the company remained fully operational and reported that 99% of its employees remained free from the virus. This included that the company was able to maintain customer demand levels, which translates to a 98% on-time delivery rate.
Customer collaboration also included the development of mutually beneficial solutions to ensure contract fulfillment. GrafTech modified some customer contracts to provide near-term relief and to secure additional volumes by extending these contracts (p. 3).

From a supplier perspective, the company remains in a very safe place as it produces most all key materials needed to produce its products.

5.1.3 Steven Madden Inc. – A great example of how COVID-19 impacted shoe retail

These findings are based on the company's Q2/20 earnings call transcript

Company details: Steven Madden is a US-based seller of affordable shoe wear and accessories. The company generated 62.2% of its 2019 sales in the wholesale footwear segment. Its brands include Steven Madden, Madden NYC, and Big Buddha. The company covers the biggest

American retail stores, including, but not limited to, Nordstrom, Dillard's, Macy's, Designer Brands, Kohl's, TJX, Burlington, Ross Stores, Wal-Mart, and Target. Only 18.0% of the company's 2019 sales were generated through its network of 225 retail stores. Additionally, 88% of its sales were generated in the United States.

Development of company performance during crisis: As a result of nationwide shelter-in-place orders, Steven Madden reported 68.2% lower sales in its second quarter. Operating income margins dropped from 3.4% in the first quarter to -12.5% in the second quarter.
Strategies taken: In the challenging second quarter, Steven Madden started to increasingly focus on all of its stakeholders as the quarter saw both COVID-19 related shutdowns and the start of riots as a result of the murder of George Floyd. The company published its first sustainability report, which outlines its CSR road map and how to imbed sustainability in processes (p. 3).

In addition to this, the company increased its liquidity position by adding a new $150 million asset-based revolving credit facility. and fired 250 corporate employees to reduce costs, and to adapt to the changed environment (p. 4).
The good news is that the company saw an improvement in its business as the reopening of stores began on May 20,2020. At the end of the quarter, the company had reopened all of its stores except for the ones in California – due to re-imposed government restrictions. However, store hours remained 25-30% shorter. The good news was that operations in the company's online segment did well, and further benefited from increased investments in digital marketing. The company also mentioned that its stock levels were too low at the end of the quarter as the initial virus wave caused new orders to rapidly decline (p. 4)

5.1.4 The Andersons Inc. – The virus impact on the American agriculture industry

These findings are based on the company's Q2/20 earnings call transcript

Company details: The Andersons is an Ohio-based company focused on storage and trade of agricultural commodities, the production of ethanol in the corn belt, the distribution of fertilizer products and the leasing of railroad cars. The company founded in 1947 therefore has a

significant exposure in the American agriculture sector, which makes it a suitable company to observe.

Development of company performance during crisis: In the second quarter, the company's sales declined by 18.7% to $1.9 billion. Operating margins fell to -2.1%.

In this quarter, the company reported mixed results as the fertilizer distribution was up sharply (p. 2) as a result of a good planting season. These impacts were not impacted by the virus as weather conditions benefited domestic farmers. Additionally, the company expects a strong export market for grains (p. 7), which again, is a factor that impacts the company without being influenced by the pandemic. However, ethanol sales were impacted by a reduced demand in gasoline (p. 3) as global travel was down sharply as a result of shelter in place orders. The Andersons shut down its plants until demand recovered (p. 4). These shutdowns had different impacts (p. 10) as some of the plants were due for maintenance anyway while the new ELEMENT plant was just about to begin operations. Fortunately, the company was able to get production back on track at the end of the second quarter as demand rebounded. The same goes for the company's rail business as lower carload traffic was down sharply, resulting in 1/3rd of all North American railcars being idled (p. 3). Weaker demand impacted both lease rates and lowered the need for repair services.

Strategies taken: To fight a challenging market environment, management made a significant move and combined its business segments (p. 5). The trade and ethanol groups will be combined to achieve both strategic and cost savings opportunities. The combination of these two segments are expected to ease efforts to reduce long-term debt through higher free-cash flow generation. Additionally, the grain and ethanol segments will be combined (p. 7) as these are strategically aligned through the use of byproducts.

5.1.5 Sealed Air – A major packaging company in e-commerce and food markets

These findings are based on the company's Q2/20 earnings call transcript

Company details: Sealed Air, founded in 1960, is a provider of food safety and security as well as product protection solutions and equipment on a global scale. In 2019, the company generated 52.2% of its sales in the United States, followed by 21.1% in EMEA countries. APAC accounted for 15% of sales, followed by 6.8% in North America (ex. USA) and 4.9% in South America. Its two main business segments are food care, representing 60% of sales in 2019 and product care, providing 40% of sales. Its food care segment offers integrated packaging materials, equipment, and automation solutions to provide food safety and shelf life extension, and to reduce resource use for perishable food processors in the smoked and processed meats, poultry, and dairy markets. This segment sells its solutions directly to customers through its sales, marketing, and customer service personnel. Sealed Air's product care segment provides foam, corrugate, molded pulp, and wood packaging solutions to protect goods in shipping for the e-commerce, electronics, transportation, and industrial markets. This segment sells its solutions through supply distributors, as well as directly to fabricators, original equipment manufacturers, contract manufactures, third party logistics partners, e-commerce/fulfillment operations, and retail centers.

Development of company performance during crisis: In the second quarter of 2020, Sealed Air reported a decline of 0.8% in sales. The operating margin rose by 270 basis points to 17.0%.

Strategies taken: Sealed Air is a great example of a company that both quickly adjusted to a changing environment, and even benefited from the current situation (p. 3). The company mentioned a move to a touchless environment, which accelerated investments in automation and equipment products. Additionally, the company has prioritized its innovation pipeline to increase speed to market, adding more online capabilities for its customers and prospects to work with digital and smart technologies (p. 5). As a result of customer shutdowns, the company switched to automation products, and was able to deliver these once customers re-opened production. Additionally, and with regard to the company's packaging business, e-commerce outperformed while industrial packaging was weak due to mandatory shutdowns (p. 6).

Sealed Air also mentioned that their sales in Asia Pacific countries outperformed the United States as the economy overseas reopened earlier (p. 7). Adding to that, the company is working

on a program called Reinvent SEE, which aims to reduce costs and streamline production. While this was not aimed to offset COVID-19 weaknesses, it progressed nicely according to the company and actually mitigated some risks.

One of the main benefits of the company is its ability to shift its product portfolio to adjust for changing demand (p. 12). This was a measure to avoid weakness caused by aerospace, and automotive markets. The company is assisting its customers by helping to set up equipment and to better prepare them for uncertainty caused by the pandemic.

5.1.6 Tenneco Inc. – How COVID-19 impacted auto suppliers

These findings are based on the company's Q2/20 earnings call transcript

Company details: Tenneco Inc. was founded in 1940 as the Tennessee Gas and Transmission Company. The company has a volatile history based on acquisitions and spin-offs. During the 1940s and 1950s, the company was engaged in building pipelines. Nowadays, the company operates four major business segments after the 2018 acquisition of Federal-Mogul. These are clean air and powertrain products (clean air and powertrain division) as well as ride performance and motor parts products (DRiV division). The company operates on a global scale but generates 43% of its sales inside North America. 37% of sales are generated in Europe. China accounts for 11% of total sales. Moreover, Tenneco employs 78,000 employees.

On top of that, the company has a significant footprint in the global automotive industry. The clean air and powertrain division generates 8% of its sales from the Golf/Octavia platform, followed by 3% from the F-150 platform. Its top customers with 41% of total sales are General Motors, Ford Motors, VW Group, and the Daimler AG. Its products are focused on lowering emissions, increasing the fuel economy and durability, and benefit from tightening global emission controls.

The same goes for the DRiV segment which provides advanced ride performance and aftermarket products from brands like MOOG, Wagner, Öhlins, and Clevite. This division is well diversified with its top 5 customers only accounting for roughly 25% of sales – including

Advance Auto Parts and O'Reilly Auto Parts. Especially a rapidly rising average auto age is benefiting this division. For example, the number of vehicles in North America that are between 6 and 13 years old is expected to rise from 116 million in 2020 to 138 million in 2025. In China, this number is expected to rise from 99 million to 152 million.

Development of company performance during crisis: In the second quarter, Tenneco reported a sales decline of 41.5%. Operating income took a $194.2 million hit as the operating margin fell to -6.8%. A core problem the company faced was a widespread automotive production shutdown, which did not ease until May and June (p. 2).
Strategies taken: The company accelerated cost cutting measures to achieve positive adjusted EBITDA in its second quarter (p. 2). Tenneco estimates that temporary cost cutting actions resulted in 500 to 600 basis points higher operating margins (p. 3). Most temporary cost cutting methods included furloughs and salary reduction (p. 3). In addition to cost cutting methods, the company benefited from its aforementioned global diversification (p. 3). As the pandemic-related lockdowns eased in Asia before they were rapidly enforced in the United States, the company was able to somewhat offset weakness.

Based on the COVID-19 events, and with an eye on shareholder value, the company has four areas that are expected to drive value (p. 5). Tenneco will be focusing on reducing structural costs as part of its Accelerate+ program and look for opportunities to support margins and returns. Second, management aims to reduce capital intensity for both capital expenditure and working capital. The third aim is to optimize the company's product portfolio. Management has instituted a value stream simplification process across its operation using 80%/20% value analytics. The fourth focus area is aimed at increasing investments in growth targets. Higher return on capital opportunities like Motor parts in North America, Europe, and China will offset weakness in other areas (p. 6).

5.1.7 AAR Corp. – The pandemic impact on aerospace service providers

These findings are based on the company's Q4/20 earnings call transcript

Company details: AAR Corp was founded in 1951 and incorporated in Delaware in 1966. The company is a diversified provider of products and services to the worldwide aviation and government and defense markets. Its aviation segment accounts for 95% of total sales and focusses on supply chain and engineering services. AAR provides customized flight hour component inventory and repair programs, warranty claim management, and outsourcing programs for engine and airframe parts and components.
AAR also provides customized performance-based supply chain logistic programs in support of the U.S Department of Defense and foreign governments. These services include material planning, sourcing, logistics, information and program management, and component repair and overhaul.

In addition to this, the company generates 5% of its sales in expeditionary services. These services provide support for the movement of equipment and personnel by the U.S and foreign governments and non-governmental organizations.

Development of company performance during crisis: Based on this context, the global slow-down in aviation travel in the second calendar year quarter caused total sales to fall by 26%. The operating margin fell to just 0.2%. The main reason is the exit of certain contracts (p. 4). Total commercial sales were down 40% as higher government sales were more than offset by commercial weakness.

Strategies taken: As a result, AAR took significant steps to reduce costs. For example, as a measure to lower fixed and overhead costs, AAR closed its Goldboro and Duluth facilities and exited or restructured existing, but underperforming contracts. When it comes to selling, general, and administrative costs, management aims to further lower costs by composites divestitures, as well as by addressing underperforming programs and additional footprint realization. In addition to that, management witnessed a decline in its heavy maintenance business as it started the quarter with full hangars but witnessed a steady decline throughout the quarter. The problem AAR encountered is that most planes in hangars were not replaced due to falling maintenance demand (p. 7).

On top of its own measures, AAR has accepted payroll funding from the U.S Treasury under the CARES Act. This has secured mid-term liquidity and prohibits the payment of dividends (p. 5). Management also decided to make structural changes to its business portfolio, which is the reason why the company did not issue forward-looking guidance.
Additional measures to fight the downturn is a focus on used parts from older aircraft (p. 8). This way the company can bring more material to market to capture a greater market share as airlines to for cheaper ways to maintain their aircrafts.

Based on all aforementioned factors, the company is preparing for an extended period of depressed flying (p. 11).

5.1.8 Valero Energy Corp. – how lower travel numbers impact gasoline demand and pricing

These findings are based on the company's Q2/20 earnings call transcript

Company details: The reason Valero Energy is an interesting company to analyze is because of its exposure in the energy industry. Valero is a Fortune 500 company based on San Antonio, Texas. The company owns 15 petroleum refineries located in the United States, Canada, and the United Kingdom with a throughput capacity of 3.15 million barrels per day. The company also owns 14 ethanol plants in the Mid-Continent region of the U.S. with a production capacity of 1.73 billion gallons per year.

Development of company performance during crisis: As a result of the shelter in place orders in the second quarter, Valero reported a 65.1% revenue decline in its second quarter.

Strategies taken: First of all, because Valero is critical infrastructure, it was not subject to mandatory closure as a way to combat the virus. Hence, it was a reason that allowed the company to retain all of its employees without having to furlough or reduce salaries (p. 3). Nonetheless, the company has implemented work from home measures and reduced the output of its ethanol plants as demand fell by 50% in April (p. 3). The company lowered its 2020 capital

budget by $400 million, raised $1.5 billion in debt at low rates, and secured an additional credit facility – which remained undrawn (p. 3).
However, capital expenditures in growth projects like the Diamon Green Diesel expansion project were not cut as these projects are expected to be significant drivers of earnings in the future, while providing stability in the near-term (p. 4). This segment averaged 795,000 gallons per day in the second quarter, which is an increase of 26,000 gallons compared to the prior-year quarter (p. 5).
On a full-year basis, the company expects to invest $2.1 billion in capital investments. 40% of this is expected to flow into growth projects (p. 6). Given that 'traditional' refinery sales account for 95% of total sales, the company is clearly pivoting to investments that are less cyclical.

Renewable energy investments are also a way to hedge against political factors like a potential Biden presidency. The company does not expect that any administration would pull the rug out from farmlands – which are providers of supplies for this industry (p. 11).

The company also made a number of comments with regard to the environmental plans of a possible Biden administration (p. 17/18). It is unsure how a possible carbon tax is going to be structured. However, while Valero does not have the ability to influence these decisions, it would not make sense to impose a carbon tax while the economy is just recovering. In addition to that, Valero is one of the largest producers of energy, which is always needed to keep an economy running.

5.1.9 Terex Corp. – Construction in times of COVID-19

These findings are based on the company's Q2/20 earnings call transcript

Company details: Founded in 1986, Terex has become a global leader in aerial work platforms ("AWP") and materials processing machinery ("MP"). Its AWP segment covers a wide variety of products including utility equipment, aerial work platforms, telehandlers, and light towers. The company's MP segment includes crushers, washing systems, screens, apron feeders, material handlers, pick and carry cranes, wood processing, biomass and recycling equipment,

concrete mixer trucks and concrete pavers, conveyors, and their related components and replacement parts.

In prior years, the company has discontinued a lot of operations. For example, in 2019, Terex sold its mobile cranes division to Tadano Ltd. Two years prior to that, the company sold its material handling and port solutions ("MHPS") segment.

Basically, the company is well-positioned in the Capex supply chain of mining and construction industries. Its business model is both cyclical and able to generate long-term growth. For example, new orders/bookings in Q2/20 were down significantly as AWP orders were roughly 1/3rd of 'normal' levels. MP orders were 50% below the 2018 peak. Note that orders more than doubled during the prior upswing (2016-2018).

Development of company performance during crisis: In its second quarter, Terex reported a sales decline of 47.2% with operating income dropping 92.5% as the operating margin declined to 1.4%. A part of the poor performance was caused by order cancellations (p. 11).

Strategies taken: One of the company's strengths going into the pandemic is its Zero Harm safety culture of Think Safe, Work Safe, Home Safe (p. 2). This system, which was implemented ahead of the pandemic, made it possible that only a small number of employees contracted the virus. The company implemented additional measures, which resulted in smooth operations throughout the pandemic as operations were not impacted. Unfortunately, these measures went into full effect after March as the company was prone to government mandated shutdowns in the month of March.

As a result, the company had to focus on variable manufacturing expenses as these account for 80% of the company's cost of goods sold (p. 3). Hence, management focused on customers to better understand demand. This was connected to a narrow focus on suppliers to control incoming supply of materials to maintain a high utilization rate. In addition to that, the company works on a Focus, Simplify, and Execute To Win strategy. This includes product innovation to help lowering manufacturing costs and costs customers incur to operate their equipment. Its

newest J-Boom product is an example of such innovation as it offers a good work height and unrestricted platform capacity (p. 3). This way the company is able to benefit regardless of the pandemic by offsetting risk through innovation. Terex is also helping its distribution partners by providing easy-to-use digital tools to integrate and consolidate data into a digital portal. Hence, improving efficiency (p. 3).

5.1.10 Alcoa Corp. – Construction in times of COVID-19

These findings are based on the company's Q2/20 earnings call transcript

Company details: Alcoa (a portmanteau of Aluminum Company of America) is the world's eighth-largest producer of aluminum with a current market cap of $2.19 billion. The company was founded in 1888 and is headquartered in Pittsburgh PA. In 2016, the company decided to fully focus on aluminum production as it split into two companies. Alcoa, which is engaged in the mining and manufacturing of raw aluminum, and Arconic (ARNC), which processes aluminum and other metals. The 2016 split is the reason why some charting and fundamental data services only go back to 2016 as Arconic was the official RemainCo.

That said, Alcoa, which currently employs roughly 13,800 employees in 30 operating locations across nine countries, generates roughly 40% of its sales inside of the United States. The company focuses on bauxite, alumina, and aluminum products. Aluminum metal is produced by refining alumina oxide from bauxite into alumina, which is then smelted into aluminum and can be cast and rolled into many shapes and forms. This means that the company is both prone to the aluminum price traded on the London Metal Exchange and the Alumina Price Index (API) and has do deal with a lot of intercompany sales to produce both alumina and aluminum from bauxite. For example, in Q1 of 2020, 79% of bauxite sales were intersegment sales followed by 32% of intersegment sales in the alumina segment. Aluminum saw 100% third-party sales as a result of a sole focus on raw material production.

Development of company performance during crisis: In the second quarter, Alcoa reported a sales decline of 20.8%. Operating income dropped by 100.9% as the operating income margin fell to -0.1%.

In order to navigate through this market, Alcoa has established three strategic priorities to reduce complexity, drive returns, and advance sustainability (p. 3). This will allow the company to remain competitive and not only withstand the changes caused by the pandemic.

With regard to daily operations, the company did not see any interruptions as bauxite production reached a record in the first six months of 2020 (p. 3). Regardless, the company issued new debt at a rate lower than any of its existing debt to fund liquidity in an uncertain time. This shows that investors trust this cyclical company even in an economic depression (p. 3).

Strategies taken: To protect its employees, the company was one of the first firms to restrict global travel. This has caused only 2% of the company to be affected by the virus at the end of the second quarter (p. 4). In February, the company established a global crisis response team and conducted supply and staffing contingency planning. Management makes the case that its health response plan was developed based on best practices and was input from its own medical experts and external sources. (p. 4).

With regard to the company's operating performance, there was a focus on increased productivity based on strong collaboration cross all operations and centralized resources. This included leveraging technical expertise, information systems, and the creativity of employees to accelerate the productivity program (p. 5).

The company's global presence also allowed it to benefit from aluminums crap shortages in China as this benefited total demand while other markets slowed (p. 6). Especially because markets in Europe and North America started their recovery in May and June. Regardless, Alcoa decided to sell non-core assets to raise cash in case the economy were not about to recover quickly (p. 7) while further focusing on the aforementioned programs to streamline production and keep employees safe.

5.2 Answering propositions

Based on the best practices research and study of quarterly transcripts, the propositions can be answered using the data discussed in part 5.1.

Proposition 1: COVID-19 has increased the negative impact from supply, process, demand, control, and environmental risk, resulting in a significant negative impact on both supply chain and financial indicators.

Based on the aforementioned ten companies, there is clear evidence that COVID-19 has a severe negative impact (table 9). All firms except for Valero and Sealed Air saw negative sales growth. In the case of Valero, this is because of GAAP data. Adjusted for unusual items, the company would be showing a decline. All companies had to deal with uncertainty as demand saw strong volatility. In some cases, because of government mandated lockdowns, and in some cases because customers avoided certain products or industries. However, companies like Armstrong Flooring saw strong demand in certain areas as residential housing benefited from the COVID-19 surge as citizen where moving to the suburbs, which caused a building activity to rise. Additionally, The Andersons witnessed strong demand in grain trade. This is because of macro factors that were not impacted by the pandemic. In most cases, companies had to work with suppliers as logistics issues and timing of delivery and volumes were key in managing margins as lower sales already pressured margins. In some cases, production downtime occurred because of either mandated lockdowns or because demand was so low that production had to be cut.

Based on the findings, it can be said that demand was much more impacted than supply. While almost all companies started to work closer with suppliers to manage margins and supply, it seems that a lack of supply, or a lack of satisfying supply quality was not a problem companies encountered. In other words, while one can make the case that supply was an issue, the case cannot be made that COVID-19 generated significant supply problems as every company witnessed problems due to lower (end)-user demand. If demand improved, supply almost immediately satisfied this demand. This was clearly visible in The Andersons and Valero Energy case as both companies ramped up production as demand came back. Steven Madden saw the same as its major problem was a shutdown of retail stores, which is key to its own distribution. The impact on environmental risk is hard to analyze as COVID-19 in itself is an environmental risk. However, based on the theoretical framework, environmental risk is risk associated with the

flow between demand, supply, and company operations. Given that all firms had to take measures to reduce uncertainty, whether it was because of supply, demand, or process risk, it can be said that environmental risk was unusually high. Therefore, this paper makes the case that environmental risk, too, was higher due to COVID-19.

Process risk is also a risk category that was significantly impacted by COVID-19. Based on the companies in this paper, it can be said that processes of 'al kinds' were impacted as all processes that involved human interaction had to be made safer. Overall, it should be assumed that this worked as no company saw significant supply risk, meaning overall, the capability to deal with orders was not impacted. Nonetheless, solely based on the fact that companies increased their efforts to make human interaction safe, it can be concluded that operations were negatively impacted by COVID-19.

Table 9 Overview of Q2/20 financial performance and earnings expectations per company.

Company	Sales Growth	Operating Income Growth	Operating Income Margin	Reported EPS	Expected EPS
Armstrong Flooring	-18.1%	-332.0%	-8.0%	N/A	N/A
GrafTech International	-41.6%	-50.1%	47.5%	N/A	N/A
Steven Madden	-68.2%	-136.5%	-12.5%	$ (0.19)	$ (0.27)
The Andersons	-18.7%	-70.0%	0.9%	$ 0.88	$ (0.28)
Sealed Air	-0.8%	17.7%	17.0%	$ 0.76	$ 0.57
Tenneco	-41.5%	-194.2%	-6.8%	$ (2.15)	$ (3.39)
AAR Corp.	-26.0%	-96.6%	0.2%	$ 0.26	$ (0.29)
Valero Energy	-65.1%	96.1%	18.7%	$ (1.25)	$ (1.40)
Terex	-47.2%	-92.5%	1.4%	$ (0.05)	$ (0.61)
Alcoa	-20.8%	-100.9%	0.1%	$ (0.02)	$ (0.38)

Performance indicators were severely impacted (table 9). All companies but Valero and Sealed Air saw a significant sales decline. As previously mentioned, Valero's adjusted sales would also be down as table 9 shows GAAP data. Multiple companies reported delivery dependability to be an issue, even though the impact on sales was mainly caused by demand. It was also hard to establish the factor of customer satisfaction as most spending was lower because of economic factors. Regardless, Sealed Air was able to work with customers to prepare them for the current pandemic and future factors by offering advanced products. This would mean that while in general, there is a negative impact on supply chains due to lower demand and production shutdowns, some companies were able to benefit from such an event. However, while there was a negative impact on supply chains, there was not enough evidence to make the case that supply

chains were distressed. That would have been the case if firms had reported the inability to continue daily operations due to, for example, a lack of supplies. Evidence in this research suggests that problems moved upstream, starting with slower demand due to enforced lockdown measures. However, given the limited sample size, these findings cannot rule out that supply issues impacted certain areas of the economy.

Proposition 2: supplier collaboration, internal collaboration, customer collaboration, higher R&D spending, and early supplier involvement are expected to play a significant role in company's best practice to mitigate supply chain risks.

All factors included in proposition 3, except for early supplier integration, were found to be applied. In this case, and according to table 9, all companies with available data beat earnings per share estimates in the second quarter. It can therefore be assumed that measures were taken to enhance the performance beyond analysts' expectations. Internal collaboration was found in most companies as measures were taken to mitigate the health risks of the COVID-19 pandemic. Travel restrictions, increasing work floor measures and ways to communicate with clients were examples of measures to manage inter-employee relations. Additionally, Steven Madden took measures to increase the number of meetings with management and employees to increase transparency. With regard to higher R&D spending, it was hard to define this on a qualitative basis. However, companies that had products in place that benefited from a pandemic were much better prepared than companies that did not. For example, Sealed Air provided advanced solutions for the packaging industry to reduce manual labor. Armstrong Flooring benefited from a surge in residential building while commercial building was weak. Steven Madden was unable to do this as the company was dependent on brick-and-mortar stores. GrafTech might not have increased R&D spending, but cost-savings led by Brookfield significantly improved margins and prepared the company for any negative impacts. They more than likely did not have COVID-19 in mind when Brookfield bought the company, but higher margins partially offset a decline in demand.

Additionally, early supplier integration has not found enough evidence to make a clear case that this mitigation strategy works. However, as Sealed Air has supported its own customer in an early stage, it can be said that they created a case of early supplier involvement. However, this

would not be entirely according to the theoretical framework as early supplier innovation describes a situation where a given company benefits from letting a third-party in on its development process. However, because Sealed Air has spotted the need for innovation, this can be considered to be a case of early supplier involvement, even it it might be from the point of view of its customers.

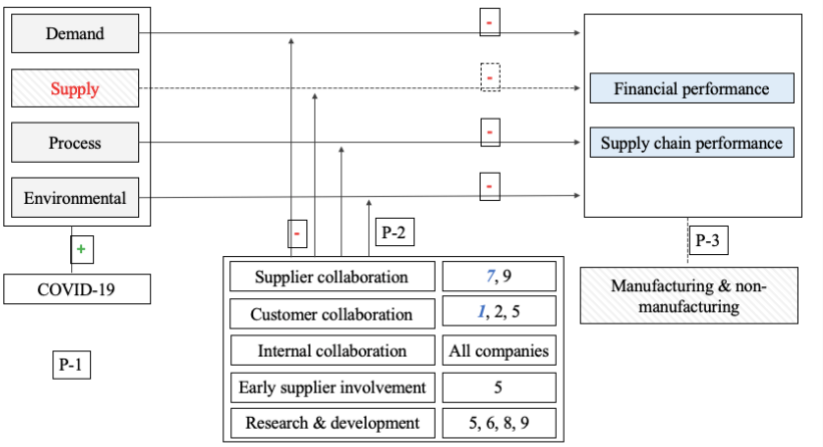
Proposition 3: Manufacturing and non-manufacturing firms will report significant differences with regard to applied mitigation strategies as both sectors will likely be differently influenced with regard to demand, supply, process, and environmental risks.

Given the somewhat limited sample size and qualitative research method, it is hard to reach a consensus on this answer. However, the observation was that companies with low fixed costs were able to achieve more financial room to mitigate risks. This is the case in manufacturing firms with economies of scale and service companies with limited capital expenditures. In this case Steven Madden saw a steep decline in sales and a drop in its operating margin below 0%. This seems to be common among retail companies.

Small (1997, p. 19) found that the profit margins across both manufacturing and non-manufacturing firms are highly cyclical but also that there are only relatively minor differences in the behavior of firm profit margins during cycles and between various sectors of manufacturing and retailing. However, this does not refute this proposition. It merely supports the case that it is not possible to make the case that one sector has higher margins than the other and therefore needs different mitigation strategies. This proposition shows that companies are always dependent on their own niche market when it comes to mitigating risks. They can use certain advantages and avoid risks that only apply to them. This was visible as only a small number of companies had to deal with mandatory shutdowns. Also, some companies can cut costs more easily than others. Proposition 3 is a clear sign that companies need to find their own strengths and weaknesses and build on this.

Figure 6 shows a complete overview of the findings indicating that there was no significant relationship between supply risk and performance indicators. There was also no clear distinction between manufacturing and non-manufacturing firms.

Figure 6 Research model. Vertical lines indicate no significant impact. Numbers display companies in research sample, in order as presented in research paper. Blue numbers (7, 1) indicate service-related companies.



6. Discussion and implications

6.1 Discussion of the results

The aim of this study was to find best practices that explained which established supply chain risk strategies were used to mitigate prominent supply chain risks in the period dominated by the spread of the novel virus COVID-19 in the United States. The study also looked for differences between manufacturing and non-manufacturing firms. A key finding confirmed earlier findings by Christopher and Peck (2004, p. 2) who argued that supply chain resilience is the ability of a system to return to its original state or move to a new, more desirable state after being disturbed. This has been the main finding based on best practices among both manufacturing and non-manufacturing firms. For example, companies either created the resources to return to a normal state of business as they perceived current weakness as a temporary headwind. Valero Energy and The Andersons are examples of such a scenario as both reduced production, preserved capital and in Valero's case raised liquidity to boost operations in case demand returned. Armstrong Flooring and Sealed Air, however, focused on new markets that did better during the pandemic and shifted assets towards these profitable industries/trends. Especially during these

times, it seems that risks of being ‘stuck in the middle’ is rising as companies need to make significant strategic decisions that likely decide the company’s future performance (Pertusa-Ortega, Molina-Azorín, & Claver-Cortés, 2009, p. 508). Additionally, firms like GrafTech International, who significantly lowered costs ahead of the pandemic were able to maintain relatively high levels of safety to withstand the pandemic. This is a key takeaway as companies are found to benefit more from efficiency-oriented moves than from entrepreneurial moves when it comes to successful business transformations (Hambrick & Schecter, 1983, p. 231).

Additionally, findings showed a strong impact from COVID-19 on all four risk categories as described in the research model (figure 5). While not every company commented on all risk factors (demand, supply, process, and environmental risk), comments showed that demand volatility was an issue across all companies. Most firms saw a significant decline in sales, while others saw a shift in demand to more favorable products. Sodhi and Tang (2020, p. 1) seemed to confirm these findings to a large extent as they concluded that some companies with better pre-COVID-19 preparation benefited from certain trends. They also included the call for government help in a disruptive economic environment. Other than that, research is clearly lagging a clear assessment of risks and opportunities and differences between companies and industries as discussed in this research paper. This is likely due to the fact that researchers wait for the pandemic to end in order to assess the bigger picture instead of only the biggest hit of uncertainty in the first two quarters of 2020.

Supply risk was not a core issue according to the definition of Kraljic (1983, p. 109) who considered supply scarcity, the pact of technology, the materials substitution, entry barriers, and logistics cost to be factors. Most surveyed companies are in the early stages of a certain supply chain. This does not take away all risks, but it lowers the risks. However, the importance with regard to supply risk is that companies managed supply risk through management of delivery quantities and frequency to avoid pressure on margins and operating performances. This correspondents with findings from Chen et al. (2013, p. 2187) who considered supply risk to be the potential deviations in the inbound supply in terms of time, quality and quantity that may result in uncompleted orders. Additionally, his research did not find a significant impact from supply risk on the supply chain performance. This study confirms these findings on a qualitative

basis. This also means that with regard to performance indicators, only the financial performance was negatively impacted. While initially expectations were that globalization has reached its limits (Farrell & Newman, 2020, p. 1), there is little evidence that supply chains in the United States are damaged as only end-user demand was a core reason for weakness. Companies throughout the supply chains closely coordinated the flow of information and liquidity, resulting in lower trade, but no notable supply chain breakdowns.

Concluding, it can be said that all proposed mitigation strategies are used in best practices. Regardless of whether a company is a manufacturing firm or non-manufacturing firm, it has proven to be beneficial to have a strong focus on cost cutting through internal collaboration, to focus on a smooth flow of information and liquidity with suppliers, and to closely work together with customers to satisfy changing demand. Research and development should be used to position a company's products and services in a way that even a shutdown cannot completely de-rail operations, and to make sure that a company is exploiting the right business trends. This crisis has shown that unprepared companies were simply unable to cope with the massive change in the business environment, which is the case especially for smaller companies (Wang, Yang, Iverson, & Kluender, 2020, p. 14).

Based on this context, figure 6 provides a graphic display of the findings. First of all, it shows that out of four risk categories, COVID-19 only significantly impacted demand, process, and environmental risks. While there might be evidence in other samples, it is not possible to say that supply of sampled companies was at significant risk. This supports the earlier findings from Chen et al. (2013, p. 2194) who found no significant relationship between supply risk and supply chain performance. However, both the financial and supply chain performance were found to be impacted. While no evidence was found that supported a partial breakdown of supply chains, the increased risks and need to focus on supply continuity caused the risks on both performance indicators to be significant according to this study. With regard to mitigation strategies, this visual overview shows the distributions. In this case, all companies engaged in internal collaboration. This was done through the protection of employees, more meetings. Research and development followed as companies engaged in product enhancements and a better market position. According to these earnings calls, this paid off. Supplier collaboration was also used, but less than customer collaboration. This makes sense as supply risks were found to be less

significant than demand risks. Early supplier involvement was only found once. This could be due to a low sample size, but also because early supplier involvement is an action that often occurs during a new product launch. This is not something that was typically the case in the first months of the COVID-19 pandemic.

6.2 Implications and future research directions

The practical implications of this research lay in the field of both academic research as well as public and private management. The results of this study show best practices of both manufacturing and service companies and the impact the pandemic had on financial results and the operating performance of these corporations. With regard to academic research, a future focus could be on the quantification of best practices. Whereas this research paper has established a qualitative overview of best practices based on three propositions, future research could test these findings based on quantitative research and based on an extensive survey. This would make it harder to establish new best practices, but it could find support of the findings in this paper. For example, researchers could test whether firms implemented cost cutting measures, and if they did, when they did it. There seems to be a significant benefit among companies going into the pandemic with a cleaned balance sheet and reduced operating complexity like GrafTech International. Other companies, like Steven Madden, who had no choice but to comply with regulatory shutdowns were worse off.

Based on this context, a recommendation for future research would be to increasingly focus on earnings transcripts. This novel approach has provided this research paper with a unique edge and can be used for a number of different purposes going forward. For example, researchers can use a number of transcripts per company to monitor management comments throughout the entire COVID-19 pandemic, or analyze transcripts based on a coding scheme to compare keywords in order to build an advanced quantitative comparison between companies, industries, and or pandemics. In other words, a significant takeaway from this paper would be to stimulate a push towards earnings transcripts as a way for both financial and purchasing/supply chain researchers to use this unique way of conducting both quantitative and qualitative research.

In addition to that, as this study aimed to focus on companies that outperformed analyst expectations in the second quarter, future research might benefit from a focus on companies that

performed below expectations to find out what they did differently and how this compared to the companies that outperformed in their industry.

A concrete future research idea could be to focus on the difference of strategies between industries instead of sectors. For example, “What are the main differences between risk mitigation strategies among different industry leaders, and how did they impact the performance throughout the COVID-19 pandemic”. Another idea is the focus on the development of strategies. I.e. “how, if at all, do companies adjust their risk mitigation strategies, and what causes these changes?”.

On a different note, as this study has a relatively small sample size. Sandelowski (1995, p. 179) argued that determining an adequate sample size in qualitative research is a matter of judgement and experience. This includes evaluating the quality of the information collected against the uses to which it will be put. Based on this, it would be appropriate to retest the findings in this paper based on either a larger sample size, or a sample size based on companies in different industries or different stages of the supply chain.

6.3 Limitations of this study

Some of the limitations can be considered to be future research points as discussed in chapter 6.2. The core limitations of this study are connected to its limited sample size. In this case, a small sample size reduced the number of different industries, the number of small- and large cap companies and the stages in a certain supply chain. Additionally, the findings of this paper were dependent on the information executives gave during their quarterly earnings call. While managers, in general, are reluctant to provide information that hasn’t been released through official company statements, it remains a strong limitation as further insights could not be analyzed.

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Appendix

Appendix A

Table 10 Based on Parast (2020), p. 12

Risk type	Questions need to cover:
Demand	Demand volatility
	Trouble estimating demand
	Unusual customer payment delays
	Canceled orders
Supply	Poor logistics performance
	Supplier quality problems
	Supplier bankruptcies
	Supply shortages
Process	Unplanned production downtime
	IT infrastructure problems
Environment	Political instability
	Terror attacks
	Diseases or pandemics
	Natural disasters
	Changes in political environment
	Administrative barriers for supply chains

Appendix B

- Did COVID-19 have a negative impact on your business?
    - Did your company see any increased demand volatility, unusual customer payment delays, or canceled orders?
    - Did your company witness any supplier quality issues, supplier bankruptcy, poor supplier logistics or supply shortages?
    - Did any unplanned downtime occur during production?
        - If it did, what caused it?
    - Did your company witness an impact from political instability, social unrests, pandemics, and or administrative barriers?

- How did your company's supply chain performance change during the COVID-19 pandemic?
    - Did you witness a decline in order fill capacity?

  - Were you unable to keep up your delivery dependability?
  - Was customer satisfaction negatively impacted during the pandemic?
  - Were you able to maintain your pre-pandemic delivery speed?

- What best practice strategy did you apply to combat the negative impact of the pandemic?
  - Did you enhance supplier collaboration?
    - I.e. product quality enhancement, problem solving, engaging in continuous improvements
  - Was internal collaboration improved?
    - I.e. cross-functional teams to solve problems, better communication with senior management, arranged routine meetings, used informal face-to-face meetings, encourage openness and teamwork.
  - Did the company improve customer collaboration?
    - Commitments to good relationships with customers, willingness to make adjustments to support customer relationships, maintaining interactive, two-way communications with customers, cooperation with customers to ensure smooth operations, regularly solving problems jointly with customers
  - Did your company increase R&D spending during, or prior to the pandemic?
    - How much was R&D increased, and what was the purpose of higher R&D spending?
    - Did you feel that higher R&D spending impacted your relationship with suppliers or customers? And if so, how?
  - Were suppliers involved in early supplier integration?
    - If this was the case, was this already done prior to the COVID-19 pandemic or was the choice made to integrate suppliers as a response to the pandemic?
    - Did it lead to cost reduction, higher margins, lower pressure from legal liabilities, and clear IP rights?

        - Were these benefits significantly impacting the company during the early stages of the pandemic?

- Is there anything your company would have done differently in hindsight?