



**SUPPLY BASE STRATEGIES AND SUPPLY CHAIN RESILIENCE DRIVEN BY  
COVID-19**

Lappeenranta–Lahti University of Technology LUT

Master's Programme in Supply Management, Master's thesis

2022

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## ABSTRACT

Lappeenranta–Lahti University of Technology LUT  
LUT School of Business and Management  
Degree Programme in Supply Management (MSM)

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### **Supply base strategies and supply chain resilience driven by COVID-19**

Master's thesis

2022

87 pages, 8 figures, 13 tables and 1 appendix

Examiners: Professor Jukka Hallikas and Associate Professor Mika Immonen

Keywords: supply base, supply chain resilience, supply disruptions, supply management

COVID-19 pandemic hit global supply chains because western companies have become dependent on Asian suppliers, outsourcing, single sourcing, and supply base reductions. These popular supply chain management practices are complicating and restricting firms from dealing with supply disruptions. At the start of the pandemic many supply disruptions, logistical bottlenecks and delivery time concerns forced companies to reassess their supply chain management practices. Supply base strategies and supply chain resilience activities influence companies' cost efficiency and overall competitiveness and offer protection from disruptions. These strategies are now more current than ever.

This thesis studied how Finnish companies will adjust their supply base strategies and supply chain resilience during and after the COVID-19 pandemic. It was found that while some traditional strategies remain popular, companies aim to reconfigure their supplier locations and sources of supply. In addition, supply chain resilience practices that increase reactivity, supplier collaboration, and demand forecasting gained remarkable popularity.

## TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT

LUT-kauppakorkeakoulu

Hankintojen johtamisen koulutusohjelma (MSM)

Juho Mäkimattila

### **Toimittajakantastrategiat ja toimitusketjun resilienssikyvykyys COVID-19 myötä**

Kauppätieteiden pro gradu -tutkielma

2022

87 sivua, 8 kuvaa, 13 taulukkoa ja 1 liite

Tarkastajat: professori Jukka Hallikas ja tutkijaopettaja Mika Immonen

Avainsanat: toimittajakanta, resilienssikyvykyys, toimitusketjuhäiriöt, toimitusketjun hallinta

COVID-19 pandemia aiheutti toimitusketjuhäiriöitä ympäri maailman, koska länsimaiset yritykset ovat tulleet riippuvaisiksi aasialaisista toimittajista, ulkoistamisesta, yksittäisistä toimittajista ja toimittajakantojen supistamisesta. Nämä suositut toimitusketjustrategiat monimutkaistavat ja rajoittavat yrityksiä selättämästä toimitusketjuhäiriöitä. Pandemian alussa toimitusketjuhäiriöt, logistiset pullonkaulat ja toimitusaikahuolet pakottivat yritykset pohtimaan toimitusketjun hallintaansa. Toimittajakantastrategiat ja resilienssikyvykyys vaikuttavat yritysten kustannustehokkuuteen ja kilpailukykyyn sekä suojaavat toimitusketjuja häiriöiltä. Nyt kyseiset toimitusketjustrategiat ovat ajankohtaisempia kuin koskaan.

Tämä pro gradu -tutkielma tutki kuinka suomalaiset yritykset muuttavat toimittajakantastrategioitaan ja resilienssitoimintojaan koronaviruspandemian aikana ja sen jälkeen. Tutkimuksessa selvisi, että vaikka jotkin perinteisistä strategioista pysyvät suosittuina, yritykset pyrkivät uudistamaan toimittajiensa sijaintia ja hankintalähteitään. Lisäksi resilienssikyvykyyttä parantavat keinot, joilla pyritään lisäämään reaktiivisuutta, toimittajayhteistyötä ja kysynnän ennustamista, saavuttivat merkittävää suosiota.

## ACKNOWLEDGEMENTS

Thank you Jukka Hallikas for your guidance and feedback, and thanks to everyone participating in the survey.

In Raisio, 24.4.2022

Juho Mäkimattila

## ABBREVIATIONS

IT	Information technology
SCM	Supply chain management
SCRM	Supply chain risk management
SD	Standard deviation
SM	Supply management
SME	Small and medium-sized enterprises
SRM	Supplier relationship management
WTO	World Trade Organization

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## 1. Introduction

COVID-19 pandemic started from China in late 2019. As most countries, companies and people were unprepared for the unexpected, the virus spread all over the world in early 2020. As a consequence, many restrictions had to take place which disrupted global supply chains. As Handfield, Graham & Burns (2020, 1651-1652) point out, COVID-19 pandemic hit both upstream and downstream material flows of global supply chains because western manufacturers have become dependent on Asian suppliers after focusing mainly on lowest landed costs. Moreover, complex supply chains are also prone to other rare disruptions, such as natural disasters like floods, tsunamis, earthquakes or fires, and man-made disasters like transport accidents and labor strikes (Sawik 2011, 194; Torabi, Baghersad & Mansouri 2015, 22). These disruptive supply chain risks have a particularly low likelihood of occurring but have severe consequences (Torabi et al. 2015, 23).

Lin, Fan, Shi & Fu (2021, 2) argue that companies with more diverse supply bases can increase inventory availability and they enjoy higher profitability during the COVID-19 crisis. Interestingly, Hayakawa & Mukunoki (2021, 170) found out that negative effects of COVID-19 hurt less intra-continental trade in Asia because it was easier to mitigate negative supply chain disruptions. These findings alone suggests that supply base strategies have significant importance on company's performance when disruptive risks emerge. Due to COVID-19, these considerations have become timely.

Interestingly, as Hendricks, Singhal & Zhang (2009, 244) point out, many popular supply chain management (SCM) practices such as outsourcing, single sourcing, supplier base reduction, and some supply chain efficiency practices are complicating and restricting firms from dealing with supply disruptions. These practices are popular because complexity reductions likely result in lower transaction costs and increased supplier responsiveness (Choi & Krause 2006, 637). However, Choi & Krause (2006, 637) also agree that these practices increase supply risks. Thus, supply base strategies influence company's cost

efficiency and overall competitiveness. As van Hoek & Dobrzykowski (2021, 699) point out, these strategies are now more current than ever, as COVID-19 is causing companies to considerate their global sourcing strategies. At the start of the pandemic, many supply disruptions, logistical bottlenecks and delivery time concerns forced companies to reassess their alternative sources, sourcing locations and reshoring. Kähkönen, Evangelista, Hallikas, Immonen & Lintukangas (2021, 2) suggests COVID-19 will drive profound change on SCM.

This thesis studies how Finnish companies will adjust their supply base strategies after and during the COVID-19 pandemic. Since similar severe supply disruptions will happen also in the future, a diverse supply base would allow companies to secure the functionality of their supply chains. However, having concentrated supply base is more cost efficient and agile, and disruptive risks occur only on the rarest occasions. Thus, it is interesting to study how companies will adapt their strategies. In addition, Tang (2006a, 34) argues that by improving supply chain resilience companies can reduce costs and/or improve customer satisfaction under normal circumstances while enabling sustaining operations during and after disruption. In this light, resilience is studied as a secondary research question.

## 1.1 Research gap

As COVID-19 has caused major supply disruptions, it has been a subject of numerous academic studies in the field of supply management (SM). In fact, before September 28, 2020 there was published total of 74 COVID-19 related supply chain studies (Chowdhury, Paul, Kaisar & Maktadir 2021, 3-4). Since then, the number of studies has increased greatly. One of the most studied aspects of SM after COVID-19 crisis is supply chain resilience. For example, Kähkönen et al. (2021) surveyed total of 110 Italian and Finnish medical device companies and found out that reconfiguring supply chain operations improve resilience which helps companies to recover faster, reduce vulnerability and improve lead times. Therefore, companies must evaluate their supply bases. Finally, they found that COVID-19 caused disruptions can lead to reshoring decisions as companies relocate production from China to Europe.

When considering supply base strategies, reshoring seems to be the most studied aspect of it. It is logical since western manufacturers and first tier suppliers have become extremely dependent on global supply chains (Handfield et al. 2020, 1651). Similarly, van Hoek & Dobrzykowski (2021) executed a qualitative study of three American manufacturing companies' reshoring decisions driven by COVID-19. They found out that reshoring implementation may not be increased by COVID-19 and companies are not solely reducing reliance on Chinese suppliers. Instead, supplier diversification and sourcing locations require more comprehensive consideration, and there are also other options to reshoring, such as nearshoring and relocation of global sources to other distant countries. In addition, the authors note that COVID-19 caused reshoring reasons are mostly short- to mid-term, and reshoring processes are complex as they require consideration and implementation. Therefore, the short- to mid-term reasons could be outlived by the time it takes to implement reshoring.

Overall, complete supply base strategy implications, including sourcing types, supplier locations, and number of suppliers, affected by COVID-19 have not been studied extensively. Thus, this thesis will study supply base strategies in Finnish companies driven by COVID-19, or if there are any changes to them. And since supply chain resilience is connected to supply base strategies for example through reconfiguring activities, this thesis also studies resilience activities in detail.

## 1.2 Research objectives, questions and limitations

The main objective of this thesis is to study how Finnish companies have adjusted or how they will adjust their supply base strategies during and after COVID-19 pandemic. The strategies are examined in comparison to existing literature and theories of SM. Therefore, the main research question is:

- 1) *How has COVID-19 affected supply base strategies in Finnish companies with global supply networks?*

As supply base strategies do not cover all the strategy changes companies make, information about the additional changes needs to be assessed through a secondary research question. The secondary research question is:

2) *How will companies change their supply chain resilience approaches post-COVID-19?*

As Kähkönen et al. (2021) studied, resilience has great influence on a company's ability to mitigate disruptions. Not all resiliency activities are related to supply base management, therefore this thesis will also study if companies are aiming to improve resilience. And if so, through what activities?

Other than Finnish companies are beyond the scope of this study. Therefore, the study is limited to Finnish companies with global supply networks. The latter limitation is established to provide more relevant responses. The study is not limited to the direct changes to supply strategies because as van Hoek & Dobrzykowski (2021) point out, there are also a lot of indirect changes to supply chains that were either initiated or accelerated by the pandemic. Lastly, as the pandemic is still prolonged, the actions might still be developing or changed from the previous studies.

### 1.3 Conceptual framework

To be clear what is meant with supply base strategies, Figure 1 illustrates the basic elements of a supply base. Supply base and supplier selection is a result of three different elements: supply sources, supplier locations, and number of suppliers. These are explained in more detail in chapter 1.5.

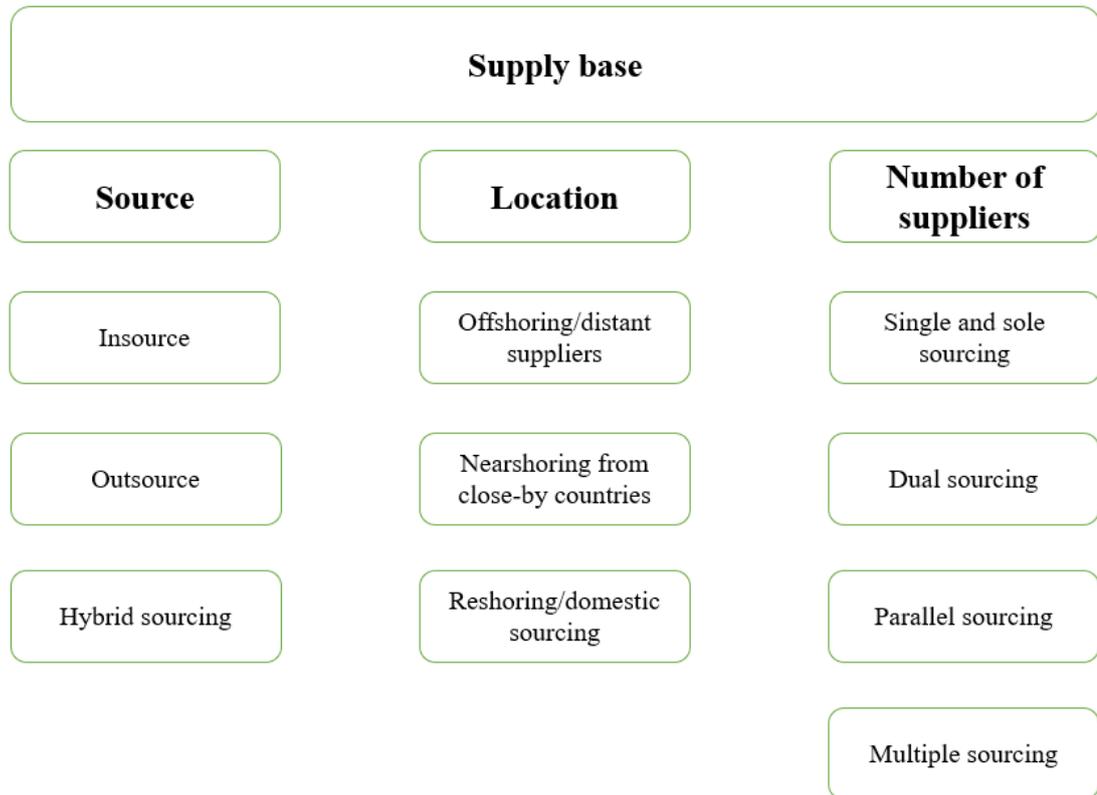


Figure 1. Elements of supply base.

To illustrate what are the main concepts of this study, to support the research questions, and to provide a clear structure of this thesis, Figure 2 visualizes the conceptual framework. It shows the theories on which the research, empirical study and analysis are based. The framework suggests that supply base of a company is based on supplier selection which follows the initial make or buy -decision. Then, supplier selection is influenced by risk management considerations. Whether it is recognised or not, each company's supply base is affected by those. As expected in the main research question, the supply base strategies are affected by COVID-19. Finally, it is assessed how the disruptive event has shaped those strategies in Finnish companies with global supply networks.

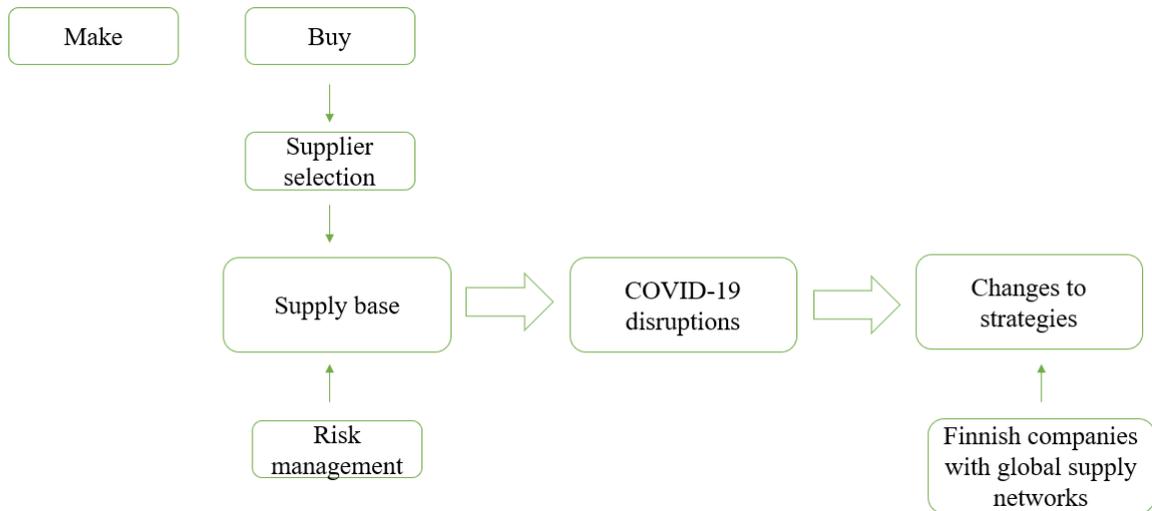


Figure 2. Conceptual framework of the thesis.

The theory in this thesis is limited to the concepts of risk management, supplier selection, and supply base. There can also be other factors which affect to the formation of supply base but as there are limits to the scope of this study, only supplier selection and risk management are studied in detail. Along with COVID-19, these concepts are reviewed in later chapters of this thesis. The structure of this thesis is explained in chapter 1.6.

#### 1.4 Research methodology

This study will be conducted with quantitative research methods. Quantitative research studies how variables are distributed between the responses, and the relationship between variables (Punch 2003, 2). In this study, the answers will be collected on a five-point Likert scale. The questions are presented as a self-administrated questionnaire. Each variable and therefore questions are based on the research questions and conceptual framework of this thesis.

The reason quantitative methodology is chosen over qualitative is that it enables larger sample of responses. In the context of this study, a larger sample provides more information about different industries, company sizes and different supply bases. This will provide more

wide understanding of the topic. The questionnaire was distributed by email to the targeted companies and the data was collected with survey tool Webropol.

Due to the number of responding companies, it can be expected to find out similarities in experiences and differences in responses to these experiences. Thus, creating comparisons between the responding companies and their responses are made during the analysis of the answers. This supports and furthers the aim of this thesis to understand how companies have adjusted their supply bases driven by the COVID-19 pandemic. Further description of the methodology is presented in chapter 6.

## 1.5 Key concepts

As discussed, and presented in Figure 1, there are several elements to consider when assembling a supply base. To begin, a supply base is defined as a group of suppliers from which a company directly purchases parts, materials, and services from. These suppliers are managed actively, and a good supply base is a well-balanced portfolio of suppliers optimally allocated to satisfy total demand and different purchasing criteria of the buying company. (Choi & Krause 2006, 637; Torabi et al. 2015, 22; Bygballe & Persson 2015, 65). Figure 3 is an illustration of the supply network of Company A. It has three tiers of suppliers that are connected to each other in various ways. However, as Company A is only directly connected to tier 1 suppliers, these four suppliers are the supply base of the company.

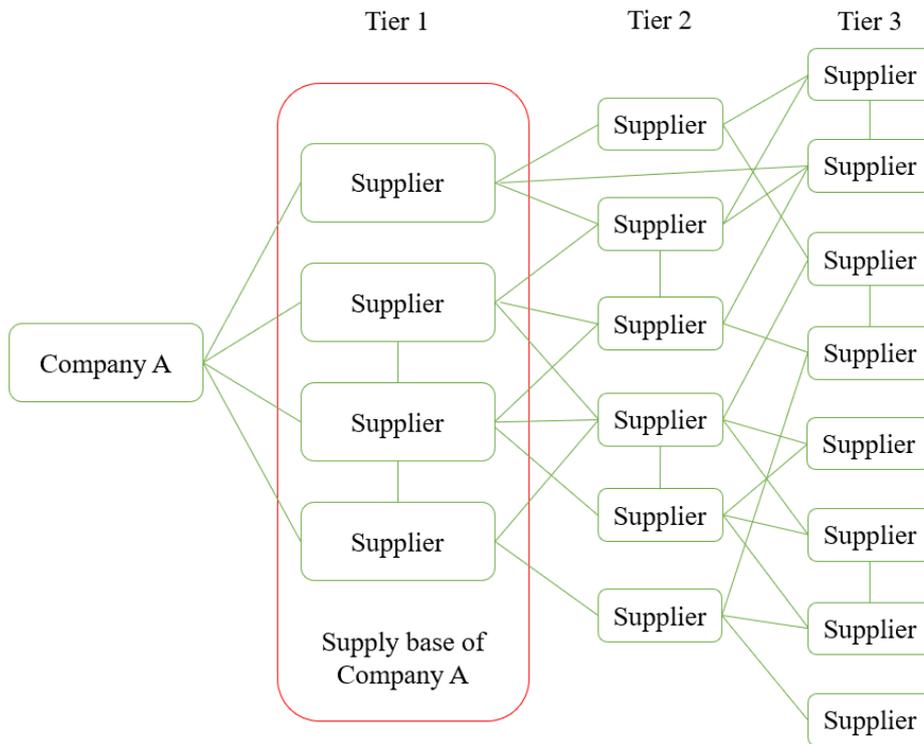


Figure 3. Supply network and the supply base.

When companies initially develop their supply strategies, the primal question is whether the company should perform a business activity themselves or should they outsource the activity to a third party (Weidenbaum 2005, 311), called the make or buy -decision. If a company decides to buy the activity from outside supplier, it must select a suitable supplier to perform it. Taherdoost & Brard (2019, 1024) define supplier selection as the process of identifying, evaluating, and contacting with suppliers. After selecting a supplier, the activity can be outsourced to them.

Outsourcing is defined as an activity where previously inhouse performed activity is transferred to a third party. The outsourced activity can be either performed service or a manufacturing of a good. (Varadarajan 2009, 1155). On the contrary, insourcing is defined as bringing back a third party performed activity to be performed inhouse (Cabral, Quelin & Maia 2014, 366). But as van Hoek & Dobrzykowski (2021, 691) point out, the line between insourcing and outsourcing is indistinct since there are two types of insourcing: (1) make inhouse or in completely owned subsidiaries, and (2) hybrid sourcing which involves joint

ventures and strategic partnerships with suppliers. The concept of outsourcing is more simple, it always involves contracting with outside supplier regardless of whether the outsourcing partner is domestic, or whether it includes offshoring or nearshoring (Hätönen & Eriksson 2009, 142).

The second consideration of supply base strategies is supplier locations. Suppliers can be domestic, or from other countries. Offshoring means relocating business activity to a distant country (Hätönen & Eriksson 2009, 143), e.g. from Europe to Asia. Thus, it refers to the location of the business activity, not whether the activity is performed inhouse or by a supplier. Similarly, nearshoring is the relocating of an activity to a nearby country (Hartman, Ogden, Wirthlin & Hazen 2017, 363-364). Reshoring is the phenomenon, where once offshored or nearshored activity is brought back to the home country (Barbieri, Boffelli, Elia, Fratocchi, Kalchschmidt & Samson 2020, 131).

Finally, it is important to consider the number of suppliers. First, it should be noted that the number of suppliers does not refer to the whole supplier base, but rather one individual sourcing category, product, or similar (Ogden 2006, 29). Yu, Zeng & Zhao (2009, 790) determine that there are three different, widely used sourcing types: single sourcing, dual sourcing, and multiple sourcing. In addition to these, also sole sourcing or parallel sourcing could be used. Sole sourcing and single sourcing are similar because company is sourcing only from one supplier. As Newman (1989) explains these two, sole sourcing is used when there is only one supplier that can fulfil the supply needs of a company. In single sourcing, the buying company commits to a single supplier from a group of comparable suppliers, although other relevant suppliers exist. Yu et al. (2009, 790) defines the dual sourcing and multiple sourcing strategies. In dual sourcing the buyer has two suppliers, but they may not be equal in terms of business share, price, reliability, and other factors. In multiple sourcing the buyer has more than two suppliers, and similarly to dual sourcing, the suppliers are not equal to each other. Finally, according to Richardson (1993, 340), parallel sourcing is the hybrid method which involves the use of multiple single suppliers for each type of components in different manufacturing units or lines.

In addition, companies must also make decisions to protect their assets. Ho, Zheng, Yildiz & Talluri (2015, 5036) defined supply chain risk management (SCRM) as “an inter-organisational collaborative endeavour utilising quantitative and qualitative risk management methodologies to identify, evaluate, mitigate and monitor unexpected macro and micro level events or conditions, which might adversely impact any part of a supply chain”. The mentioned macro events often realize disruptions to supply chains (Tang 2006a, 33) that should be countered with improved resilience. Chowdhury & Quaddus (2016, 712) define supply chain resilience as “the capability of a supply chain to prevent disruptions and to reduce the impact of disruptions through developing required level of readiness, quick response and recovery ability”.

## 1.6 Structure

This thesis is structured as follows. The literature review is presented from chapter 2 to chapter 5. Chapter 2 reviews the COVID-19 pandemic, its economic implications, and effects on global supply chains. Chapter 3 consists of literature review on supply risks by defining the most common risks companies experience and are threatened with. Then, supply chain risk management is reviewed to present how companies can mitigate the risks presented earlier. It is followed by sub-chapter about supply disruptions and resilience. Chapter 4 covers supply base strategies and how a supply base is arranged. Thus, the make or buy decision is reviewed first, followed by a sub-chapter of supplier selection. Then, traditional supply base approaches are reviewed. After that, it is examined what modifications recent literature present to these traditional approaches after COVID-19. Finally, chapter 5 reflects on chapters 3 and 4, and contemplates how companies should move forward with these strategies during and after COVID-19.

From chapter 6 the focus will be on the empirical part of the thesis. Chapter 6 will introduce and justify the chosen methodology of the empirical study in detail. The chapter will present the implementation of this study. The research approach, method and data collection are presented during the chapter. After this, the reliability and validity of the study is assessed. In chapter 7 the findings of the empirical study are presented in detail. Chapter 8 will

highlight the key findings of the study and compare them to the literature review of chapters 2-5. Finally, chapter 9 will complete this thesis. In addition to giving theoretical and managerial implications, it presents limitations of this study and topics for further research.

## 2. COVID-19 pandemic

COVID-19 pandemic began to spread the world from China in late 2019. By March 2020 most continents, including Europe and North America, were facing extreme measures to restrain the spread of the disease. Therefore, many restrictions had to take place. Offices, factories, schools, restaurants, and mass events were shut down by governments, and international travel bans were introduced. In addition, city-wide lockdowns were ordered in some countries. By late 2020 a vaccination for the disease was invented, and since early 2021 people have been vaccinated. Many localized restrictions have been in and out of use, depending on the pandemic situation at the time. Before and while people were vaccinated, new variants of the virus have emerged. As of beginning of 2022, a third round of vaccinations are given out, and there is still uncertainty about the duration of the pandemic. As a consequence of the restrictions, world economy and global supply chains have been severely impacted. Chapter 2.1 will take a look on the economic impact and chapter 2.2 on the impact on supply chains.

### 2.1 Economic impact

Figure 4 is World Trade Organization's (WTO) data about world's merchandise trade volumes between 2015 and 2022. World trade bottomed out during the second quarter of 2020, months after the pandemic spread worldwide, mostly due to the rapid implementation of restrictions on people and goods in early 2020. Since then, the bounce back has been forceful, leading to world trade reach the pre-pandemic levels during the last quarter of 2020. In addition, WTO predicts world trade to grow strongly in 2022.

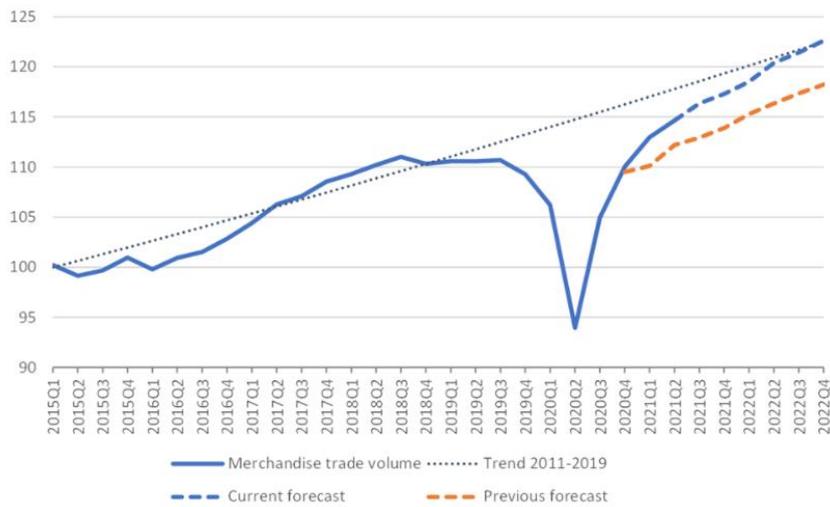


Figure 4. World trade volume 2015-2022 (WTO 2021).

While trade volumes have reached new levels, WTO (2021) notes that regional and industry disparities will remain substantial. For example, imports of Asia, North America, and Europe are expected to rise in comparison to 2019, while imports of less developed countries will fall slightly. While manufactured goods are showing good revert, services trade is lagging behind, especially in sectors such as travel and leisure.

## 2.2 Impact on supply chains

As Ivanov (2020, 2) notice, globalized and lean supply chains have become prone to pandemic outbreaks. Strange (2020, 460) points out that the distribution of goods is seriously affected by quarantines of truck drivers, pilots, and others, and many ports have been struggling. Thus, transaction costs have increased, and longer supply chains have faced more obstacles. WTO (2021) also reported COVID-19 related supply chain impacts. Most notably, they found out that shipping rates have risen dramatically, stocks of finished goods have declined, and delivery times stretched out. Sherman (2020) reported 94% of Fortune 1000 companies' supply chains have been disrupted by the pandemic.

Shih (2020) describes that many manufacturers have turned to single sourcing from niche suppliers who deliver individual components or materials for the end product. This provides companies flexibility and latest technology but exposes them to higher disruption risks when individual key suppliers operate in only one plant, region, or country. In fact, 16,3% companies of Fortune 1000 have at least one of their tier 1 suppliers in Hubei province in China, and 93,8% of Fortune 1000 companies have at least one of their tier 2 suppliers in the region (Dun & Bradstreet 2020, 2). The first case of COVID-19 was discovered in the province, leading to lengthy lockdowns in numerous cities, thus resulting in supply shortages for many companies. Choi, Rogers & Vakil (2020) blame poor supply chain mapping as the reason for poor visibility and reactivity to the supply disruptions. Small minority of companies that were prepared knew which suppliers, sites, parts, and producers were at risk and could act on the issues. Aliche, Barriball & Trautwein (2021) reported only 23% of companies have visibility into their supply chains beyond tier 1.

Aliche et al. (2021) studied during second quarter of 2021 that as a result of COVID-19 pandemic, companies have implemented increasing inventory of critical products (61% of companies), dual sourcing of raw materials (55%), regionalizing supply chains (25%), expanding backup production sites (23%), increasing supply bases (15%), and nearshoring (11%). In Finland, a survey by Finland Chamber of Commerce revealed that 84% of company executives mentioned delivery disruptions, shortages of routes, and container shortages to intervene with exports, and almost 82% mentioned purchasing and supply chain challenges, such as shortages of components and raw materials, to trouble exports (Finland Chamber of Commerce 2021). As a result, the talk of reshoring production back to Finland has increased, but cost efficiency of Chinese suppliers is keeping production in Asia (Näveri 2021).

### 3. Supply chain risks

Zsidisin (2003a, 22) states that risks exist in supply chains and when they realize, it damages the delivery of products and services to the end customer. Harland, Brenchley & Walker (2003, 51) notes that previously, when companies mostly manufactured in-house, sourced locally, and finally sold the products directly to the customers, less risks was present in supply chains, and it was easier to manage. Nowadays, as Wagner & Bode (2008, 307) point out, modern supply chains are more vulnerable than ever, and according to Hallikas & Lintukangas (2016, 488) many of these risks are related to the outsourcing of activities.

Zsidisin (2003a, 22) points out that in order to take measures for assessing the significance of risk factors and focusing company's resources to manage risks, the characteristics that influence specific risk perceptions must be understood. Thus, chapter 3.1 will identify most common risks in supply chains. Moreover, managing those risks has become a critical part of SCM, and the realization of risks can be costly failures that lead to delivery delays (Wu, Blackhurst & Chidambaram 2006, 350). Therefore, chapter 3.2 will look into SCRM. The realization of risks can also lead to severe disruptions (Wagner & Bode 2008, 309). In this light, disruptions and supply chain resilience are reviewed in chapter 3.3.

#### 3.1 Common risks

Ho et al. (2015, 5035) classify risks into two main categories, macro and micro risks. Then, macro-risks have two sub-categories of natural and man-made risks. While macro risks are external and rare events, their negative impact on companies are often severe (Ho et al. 2015, 5035; Torabi et al. 2015, 23). Typical natural risks are events such as earthquakes, tsunamis and floods, and man-made risks include transport accidents, wars, and such (Sawik 2011, 194; Torabi et al. 2015, 22). With these categories, COVID-19 pandemic can be included in natural risks. Ho et al. (2015, 5035) continue that micro risks have sub-categories of demand, manufacturing, supply, information technology (IT), transportation, and financial risks.

Micro risks are more recurring, originating from internal activities of companies and relationships within partners in the supply chain, and their impact could be less threatening. These risks are later presented in Table 1. Next, each micro risk is defined from the literature.

Johnson (2001, 110) explains product demand risks are associated with fluctuations in demand including seasonality, volatility of trends, new product adoptions, and product life cycles. Wagner & Bode (2008, 310) adds that disruptions also occur when there is a mismatch between demand projections and the actual demand, or when a supply chain is poorly coordinated. When demand risk realizes, it can lead to costly supply shortages, obsolescence, and inefficient capacity utilization.

Zsidisin (2003b, 222) defines supply risks as the probability of an incident with individual supplier failing or the supply market occurring, resulting in the buying company to fail to serve its own customers, or cause threats to customer life and safety. Trent & Monczka (1999, 934) demonstrate that the supplier failing could be for example not meeting the quality performance requirements of the buying company.

Wu et al. (2006, 352-353) define manufacturing risk as the factors and events that have an impact on the ability of companies to produce goods and services. Also, quality and timeliness of production activities and profitability are considered to be part of manufacturing risk. Thus, manufacturing risk realizes when a company can not produce goods or services at the right time, for the right amount, at the right quality or price, or something similar that leads to unfavourable consequences.

IT risks arise because modern SCM practices rely on digital information flows to ensure the place, time, quantity, and cost effectiveness of the delivery (Fischer-Preßler, Eismann, Pietrowski, Fischbach & Schoder 2020, 233). Thus, these information flows are potentially affected by external threats such as cybersecurity breaches, document forgery and counterfeiting. In addition, the lack of data can be seen as an IT risk. (Urciuoli & Hintsa 2017). Finally, as Zsidisin & Ellram (2003, 17) note, the ability of companies to stay within

the technological changes is essential. Staying behind could damage competitiveness and efficiency of the supply chain.

According to Wilson (2007, 296), transportation risk occurs when the flow of goods within the supply chain is disrupted. It is a unique risk because of its specific disruptive nature. When the transportation of goods is stopped, other operations of the supply chain are unharmed. Thus, a transportation risk arises when the material flow is interrupted, regardless of the source of the disruption.

Ho et al. (2015, 5043) studied that financial risks cover a wide range of threats. Those include institutional related issues such as exchange rate and currency fluctuations, and interest rate levels. Company specific risks include financial and insurance issues, product costs and low profit margins. Supplier specific risks include price fluctuations, loss of contract, and financial strength of suppliers. Thus, the range of financial risks are extensive and the financial issues of key member of a supply chain can affect the whole network. As Tang (2006b, 452) warns, these risks can have long-term negative effects on the financial performance of the buying company.

Table 1. Supply risks.

Risk type	Characteristics	Authors
Macro risks	External, rare, severe impact	Ho et al. 2015, Sawik 2011, Torabi et al. 2015
Natural risks	Earthquakes, flood, tsunamis, fires	Ho et al. 2015, Sawik 2011, Torabi et al. 2015
Man-made risks	War, political instability, transport accidents, labour strikes	Ho et al. 2015, Sawik 2011, Torabi et al. 2015
Micro risks	Internal, recurring, impact varies	Ho et al. 2015
Demand risk	Fluctuated demand does not meet supply, results in shortages, obsolescence, inefficient capacity utilization	Johnson 2001, Wagner & Bode 2008
Supply risk	Supplier or supply market fails to meet the requirements of buying company	Zsidisin 2003b, Trent & Monczka 1999

Manufacturing risk	Ability to produce goods and services, quality and timeliness of production, effect on profitability	Wu et al. 2006
IT risk	Technological information flows are affected by external threats, lack of data and keeping up with technology also threats to damage competitiveness and efficiency of SC's	Fischer-Preßler et al. 2020, Urciuoli & Hintsa 2017, Zsidisin & Ellram 2003
Transportation risk	Material flow disrupted during transportation, other supply chain activities remain unharmed	Wilson 2007
Financial risk	Fluctuations in institutional finance policies, company and supplier specific financial issues leading to negative effects on long-term financial performance	Ho et al. 2015, Tang 2006b

Table 1 summarizes the risks that are reviewed in this chapter. These are the most notable risks from the dozens of risk types Ho et al. (2015, 5037) presented. Next chapter will review SCRM practices, including how to mitigate these risks.

### 3.2 Supply chain risk management

Smeltzer & Siferd (1998, 44-45) suggests the goal of SCRM is to reduce risks and improve the financial returns of companies. Zsidisin & Ellram (2003, 15) clarify that instead of focusing on softening the effects of risk, companies should focus more on reducing or eliminating the source of risk. However, they believe that complete elimination of risks is unrealistic, but the goal of minimizing the probability of damaging events is realistic. Ho et al. (2015) and Hallikas, Karvonen, Pulkkinen, Virolainen & Tuominen (2004, 52) identify four steps of SCRM. They are (1) risk identification, (2) risk assessment, (3) risk mitigation, and (4) risk monitoring.

There are numerous risk identification methods presented in the literature. For example, Blos, Quaddus, Wee & Watanabe (2009, 249) present a supply chain vulnerability map approach, Trkman & McCormack (2009, 253) present a conceptual model, and Kayis & Karningsih (2012, 842) present a knowledge-based system to approach risk identification. All these methods have in common that supply chain characteristics and vulnerabilities are assessed. Then, supplier attributes, locations, performance, and relationships are identified.

Finally, sources and types of risks are also identified. As Hallikas et al. (2004, 52) point out, it is important to identify the sources of uncertainty in order to proactively manage them.

Harland, Brenchley & Walker (2003, 53) determine that there are two fundamental questions in risk assessment: (1) how likely it is that a risk will occur, and (2) what is the significance of the consequences and losses? Furthermore, these two questions can be divided further. The occurrence of the risk is dependent on the extent of the exposure to the risk, and on the likelihood of a trigger that will realise it. In addition, the realisation of the risk is influenced by internal and external factors. The second assessment should be viewed from two different points: (1) identifiable financial and tangible implications such as predetermined penalties, and (2) intangible, non-regulated consequences such as credibility and reputation losses (Harland et al. 2003, 54). Hallikas et al. (2004, 53) suggests assessing each risk an impact and probability number on a scale of 1-5 to gain more comprehensive understanding of risks a company is facing, and how critically each risk should be managed.

When it comes to risk mitigation, Zsidisin & Ellram (2003, 23) categorize SCRM practices to outcome-based and behaviour-based techniques. The outcome-based management, which aims to soften the impact of risks, fits in situations where it is not worth to engage in changing the supplier's behaviour. These techniques include SM activities such as multiple sourcing and using safety stocks. The behaviour-based management aims to reduce the probability of risk occurrence. These techniques include SM activities such as developing and certifying of suppliers, engaging in target costing and implementing quality management programs. Finally, behaviour-based management techniques can ease reducing information asymmetries between buyers and suppliers, align their objectives, and programming supplier activities (Zsidisin & Ellram 2003, 24). Hallikas & Lintukangas (2016, 490) surveyed 165 company representatives, who ranked eight different supply risk mitigation strategies. Those are, ranked from most important to the least:

- 1) Collaboration with suppliers in risk management
- 2) Avoidance of certain suppliers

- 3) Multiple sourcing
- 4) Establish and enforce contractual obligations
- 5) Avoidance of certain geographical areas
- 6) Use of local/domestic suppliers
- 7) Increase of ownership in the supply chain
- 8) Maintenance of overcapacity in the purchases

Hallikas et al. (2004, 54) also suggests risk transferring as mitigating action. Alexander & Young (1996, 730) disclose that risk can be transferred to supplier two ways. First, it can be purely transferred to supplier through contracting, but often companies must pay premium for that. In addition, it should be noted that this alternative does not reduce the risks of the supply network as a whole. Or secondly, Alexander & Young (1996, 730) point out a situation that is beneficial for both parties, as in where the supplier is better coping with changes in demand, or it has better management or practices of the process, or it uses capacity more efficiently. Therefore, risk can be reallocated between parties or reduce the total amount of risk.

Final phase of SCRM is risk monitoring, which according to Ho et al. (2015, 5050) has gained the least amount of attention in the literature. Hallikas et. al (2004, 54) advise that no company and environment is static and therefore risk statuses changes. Thus, recognized risks should be monitored to identify any changes in their probabilities and consequences. In addition, new risk factors arising should be monitored through changes in the supply network, customer needs, technology, partner strategies and competitors. If anything is noticed, they should be managed according to the presented manner.

In supply chains, or networks, there are multiple actors, and thus Hallikas et al. (2004, 57) argue companies developing their SCRM practices should communicate and share their views on risks with their suppliers. This also helps recognizing and understanding shared threats in the networks, resulting in improved understanding of risks, better decision-making

abilities, and decreased risks of both the company and its network. Actually, Hallikas & Lintukangas (2016, 492) found out that collaboration with suppliers had the highest correlation with supply risk performance out of four different alternatives. In addition, customer orientation influences the SCRM performance, likely as a mediator between customer requirements and risk management. This allows companies to adapt to changing circumstances more rapidly and therefore avoid several risks such as those related to the quality of products and services, and delays in supply chain processes. (Hallikas & Lintukangas 2016, 492-493)

Interestingly, Hallikas & Lintukangas (2016, 492) also studied that supplier dependency does not influence SCRM performance. However, as Hendricks et al. (2009, 244) point out, many scholars argue that being too dependent on suppliers is complicating companies' ability to deal with disruptions. In addition, as Tang, (2006b, 482) found out, most of these models presented in this chapter are designed for managing operational risks rather than disruption risks. Thus, supply chain disruptions and resilience that aims to mitigate disruptive events are reviewed in the next chapter.

### 3.3 Supply chain disruptions and resilience

Wagner & Bode (2008, 309) define supply disruptions as the combination of (1) unintended, irregular triggering event that realizes in the supply network, and (2) a situation resulting in significant threat to the normal business operations of the companies in the supply network. They continue (2008, 310) disruptions are severe events that have direct and indirect consequences involving time pressure, and thus decisions for mitigation must be made rapidly. Tang (2006a, 33) lists wars, economic crises, tsunamis, and many other events that has resulted in supply disruptions. Notably, COVID-19 pandemic is one event that must be added to the list. Thus, supply disruptions are mainly consequences of macro risks that were characterized earlier. Ivanov, Dolgui, Sokolov & Ivanova (2017, 6163) determined that disruptions can take place on three levels: in production, supply, and transportation.

Ivanov et al. (2017, 6165) divide mitigating disruptions into two main approaches: (1) proactive preparation before the disruption, and (2) increasing responsiveness once the disruption has happened to stabilize supply. Whitney, Luo & Heller (2014, 248) suggests that the proactive strategies are more suitable for less specific physical items, because there are more available alternative sources where capabilities required to produce them are easily acquired. When high product and asset specificity are required, it is important to develop the disruption response strategy.

When it comes to proactive strategies, Tomlin (2006, 648) suggests carrying extra inventory to mitigate disruption. Also, Rezapour, Farahani & Pourakbar (2017, 1033) mention holding downstream supply chain emergency stock of finished goods as a viable strategy. Tomlin (2009, 336) and Chopra & Sodhi (2014, 73) mention supplier diversification and using multiple sourcing to reduce the dependence on single suppliers. Chopra & Sodhi (2014, 76) also suggests regionalizing global supply chains to increase diversification of supply base and lowering transportation costs. Kahiluoto, Mäkinen & Kaseva (2020, 275) argues that supplier responsiveness is key decisive in mitigating disruptions. Thus, Chowdhury & Quaddus (2016, 722) and Lee (2021, 176) propose supplier collaboration and development as key proactive strategies. Trust and cooperation enhance supply chain visibility, and when the costs, risks, and rewards are shared between the dyad, it leads to better responsiveness. Also van Hoek (2020, 351) indicate improved supplier relationship management (SRM) practices build more resilience. Chen, Das & Ivanov (2019, 340) found out collaboration to have a positive effect on recovery ability.

However, most of these proactive actions conflict with supply chain cost efficiency, and as Tang (2006a, 34) and Rezapour et al. (2017, 1033) point out, many companies are redundant to use these costly strategies for mitigating disruptions that might not happen. Tang (2006a, 33) also suggests some of these strategies result in longer and more complex global supply chains which paradoxically are more vulnerable to disruptions. Thus, companies should invest in reactive approaches.

Reactive strategies include ramping up production at alternative suppliers (Tomlin 2006, 640), which requires using at least dual sourcing in the first place. In addition, rerouting, using alternative transportation, and using multiple routes are mentioned by Tomlin (2006, 640), Tang (2006a, 41) and Ivanov et al. (2017, 6163) as reactive options. Also, the use of back-up suppliers is presented by Ivanov et al. (2017, 6163) and Tang (2006b, 482-483). Tang (2006b, 482-483) continues that the idea of backup supplier is to shift orders to them when a major disruption occurs, but it requires some configurations about manufacturing and distribution channels. Tang (2006a, 40) presents the idea of make and buy, where part of production is done inhouse and the rest outsourced. This gives organizations flexibility, and opportunities to balance the production between a manufacturing company and suppliers. Tang (2006a, 38) and Lee (2021, 174-175) introduces postponement, which aims to standardize product designs for as long as possible, delaying the point of product differentiation. This allows cost effective and time efficient manufacturing reconfiguring in the event of disruption. Finally, Chopra & Sodhi (2014, 76-77) suggests investing in IT systems. With the help of IT, companies can screen possible disruptions, and reduce the impact of disruptions by increasing reactiveness and developing contingent recovery plans with suppliers in advance. Also Lee (2021, 174) and Chen et al. (2019, 335) speaks for digital technologies as they enable fast and smart real time sensing of demand and supply conditions, and what the impact on operations will be.

Table 2. Strategies to mitigate disruptions.

Strategy	Function	Approach	Authors
Extra inventory	More inventory buffers the effects of disruption	Proactive	Tomlin 2006, Rezapour et al. 2017
Supplier diversification/multiple sourcing	Reduce dependency on single suppliers, diversify supply base	Proactive	Tomlin 2009, Chopra & Sodhi 2014
Building regional supply chains	Diversified supply base, closeness to final customers, reduced transportation costs	Proactive	Chopra & Sodhi 2014
Supplier collaboration and development, SRM	Enhanced supplier responsiveness	Proactive	Kahiluoto et al. 2020, Chowdhury & Quaddus 2016, Lee 2021, Chen et al. 2019, van Hoek 2020

Shifting production between suppliers	Avoid disrupted suppliers/areas	Reactive	Tomlin 2006
Alternate transportation	Avoid disrupted areas	Reactive	Tomlin 2006, Tang 2006a, Ivanov et al. 2017
Back-up suppliers	Extra production capacity in case of disruptions	Reactive	Ivanov et al. 2017, Tang 2006a
Make and buy	Increased flexibility between inhouse and supplier production	Reactive	Tang 2006a
Postponement	Late differentiation of products, standardization allows more available suppliers	Reactive	Tang 2006a, Lee 2021
IT systems	Allows screening for disruptions, better reactivity and real-time sensing of supply and demand	Reactive	Chopra & Sodhi 2014, Lee 2021, Chen et al. 2019

The strategies to mitigate disruptions are presented in Table 2. One strategy alone does not provide protection from disruptive event. Therefore, Tomlin (2006, 640) suggests a mixed mitigation strategy to find an optimal approach to the issue. In addition, it should be noted that there is a fine line between a reactive and proactive approaches since many reactive strategies require proactive preparedness. Chowdhury & Quaddus (2016, 722) suggests that a quick recovery ability depends on the proactive preparation, and thus an integrated approach should be pursued.

Tang (2006a, 36) calls above mentioned strategies robust as they will help a company to sustain its operations during disruptive events. In addition, they enable a firm to manage operations efficiently during regular fluctuations. Thus, having a robust supply chain, a firm becomes more resilient. Chowdhury & Quaddus (2016, 712) define supply chain resilience as “the capability of a supply chain to prevent disruptions and to reduce the impact of disruptions through developing required level of readiness, quick response and recovery ability”. This definition is in line with the presented disruption mitigation strategies.

As Lee (2021, 176) and Ivanov & Dolgui (2020, 2904) notes, coming out as a whole from the COVID-19 pandemic requires great resilience from supply chains. Thus, several

researchers have studied the relationship between resilience and the pandemic. Handfield et al. (2020, 1653) and van Hoek & Dobrzykowski (2021, 693) calls out for better inventory management. Handfield et al. (2020, 1652-1653) suggests that adding inventories in strategic locations could be cost effective way to increase resiliency and flexibility. In addition, one manager interviewed by van Hoek & Dobrzykowski (2021, 693) named inventory management to be a good way to ensure product availability. Traditionally, extra inventory is seen as excessive fixed costs. The authors argue inventory could be cheaper than modifying a supply base. However, van Hoek (2020, 350) claims that investing short-term solutions such as inventory management may only postpone the supply issues. Paul, Chowdhury, Moktadir & Lau (2021, 325-326) suggests restructuring supply chains to better prepare for future disruptions. They recommend shortening supply chains, using local sourcing, encouraging key suppliers to locate closer to production plants, diversifying sourcing options, and improving collaboration within the supply chain. Similarly, Kähkönen et al. (2021, 15) calls out for relationship management with key suppliers and investing in supply chain planning tools to gain visibility throughout the whole network, which is essential preparedness to being able to respond to disruptions.

Frederico, Kumar & Garza-Reyes (2021, 1794) studied that strategic sourcing is relevant in SCM when disruption emerges as more coherent sourcing strategy prepare supply chains to events similar to COVID-19 pandemic. Gereffi (2020, 296-297) called for resilience that combines the benefits of global reach and local responsiveness through supply diversification. Also, Ivanov (2020, 11) and Strange (2020, 464) suggests that more diversified supply chains perform better during the pandemic as they can shift production between locations depending on the disruptions.

However, Ivanov & Dolgui (2020, 2911) suggests that because the pandemic caused extraordinarily long disruption times that changed regionally, proactive measures could only help at the beginning. Thus, the attention should aim towards situational reactivity and real-time changes. This is supported by Kähkönen et al. (2021, 15) who argue that resilience during the pandemic depends more on capabilities to re-arrange supply chains reactively.

These findings are interesting since, as discussed, companies are more reluctant to invest in proactive measures.

The most suggested improvement regarding reactiveness was improved digitalization and IT systems. Ivanov (2020, 11) argues that new digital technologies have potential to improve ripple effect control during disruption, and that utilizing data improves resilience so companies should invest in data analytics and artificial intelligence. This is supported by Paul et al. (2021, 325) who suggests data-driven supply chains to accelerate the recovery process. Finally, Kähkönen et al. (2021, 14) point out that companies that had systems for monitoring interconnections between supply chain actors did detect the COVID-19 related disruptions earlier, and therefore had better opportunities to mitigate the effects and ensure viability of their operations.

Among other reactive methods, Kähkönen et al. (2021, 16) found that realigning resources to respond with customer demand is an important coping strategy. Similarly, van Hoek (2020, 350) argues better responsiveness to demand increases the agility of a supply chain. Also logistics were identified as an important decisions by Kähkönen et al. (2020, 16) and van Hoek (2020, 349). Finally, van Hoek & Dobrzykowski (2021, 692-693) suggests reducing payment times to suppliers and changing other contract terms in favor of the suppliers to get priority and ensuring supply from suppliers, to help suppliers cope with uncertainty, and to strengthen long-term relationships with them.

To conclude, as Chopra & Sodhi (2014, 74) mention, disruptive risks require companies to build resilience despite it might cost more. On the other hand, Tang (2006a, 34) argues that resilience approaches should help companies to reduce cost and/or improve customer satisfaction under normal circumstances while enabling sustaining operations during and after disruption. Finally, Kähkönen et al. (2021, 15) capsulize that the discussed approaches help companies to recover faster, reduce their vulnerability, generate faster lead times and new sources of innovation.

## 4. Supply base formation

As called by several authors in chapter 3, supply chains can mitigate risks by using back-up suppliers, developing SRM practices with existing suppliers, and building or restructuring supply chains in a way that they have global coverage and local responsiveness. Thus, supply base formation is partly responsible for SCRM and supply chain resilience, which should be kept in mind when forming a functioning supply base. Choi & Krause (2006, 639) exemplify that a supply base consists of the suppliers that a company actively manages, whereas in supply network there are companies that the focal company is not in direct relationship with or might not be aware of. Ahtonen & Virolainen (2009, 276) studied that the size of the supply base is one of the main elements in firms' supply strategies. This is supported by Cooper, Lambert & Pagh (1997, 2) who state that the number of suppliers used for a certain product or service is an important aspect of SM. Bhatnagar & Sohal (2005, 455) found out firms' that consider more comprehensively sourcing and its locations are more competitive in performance. Thus, the size and location of suppliers are critical decisions. In fact, Ogden (2006, 29) states that supply base management is crucial strategic area of SM. Before a supply base is formed, a company must contemplate the make or buy decision, and select suppliers. Therefore, chapter 4.1 will review the make or buy decision, and chapter 4.2 supplier selection. Chapter 4.3 will examine traditional supply base size considerations and chapter 4.4 will look into different sourcing strategies, both of which are vulnerable to disruptions according to Choi & Krause (2006, 637) and van Hoek & Dobrzykowski (2021, 699). Therefore, recent supply base strategy contemplations which aim to better performance during disruptions are reviewed in chapter 4.5.

### 4.1 Make or buy

Make or buy, or in other words whether to insource or outsource products, is the fundamental question companies face. Recently, the consensus has been that in order to use resources effectively, activities that are within the core competencies of a company should be

insourced (Berger et al. 2004, 14; Weidenbaum 2005, 312). Alexander & Young (1996, 117) define core competencies to have four features:

- 1) Activities traditionally performed internally
- 2) Activities critical to business performance
- 3) Activities creating current or potential competitive advantage
- 4) Activities that will influence future growth or innovation

Other non-core and less critical activities should be outsourced to suppliers (Weidenbaum 2005, 312; Berger et al. 2004, 14). Berger et al. (2004, 14) note that this thinking is behind the phenomenon of strategic sourcing becoming integral to the long-term strategy and success of companies. By outsourcing rest of the activities, more time and resources can be used on core competencies which produce the most value (Gewald & Dibbern 2009, 251), increasing the operational effectiveness of companies. In fact, Gewald & Dibbern (2009, 254) found out in their research that the opportunity to focus on core competencies is the strongest and most recognized benefit of outsourcing.

In addition, increasing pressures to reduce cost structures and expected efficiency increases has also turned companies to outsourcing (Cousins 1999, 145; McIvor 2009, 45), as it allows companies to reduce fixed costs. Bygballe & Persson (2015, 64) also mention competition intensified by globalization and rapid technological development to be the reasons behind the outsourcing trend. McIvor (2009, 46) notes, when outsourcing an activity, a company should consider the impact of the activity on competitive advantage, capability of the company in the activity compared to competitors and suppliers, and supply market conditions.

The risks are previously discussed, but outsourcing has many benefits to offer compared to insourcing. As Quélin & Duhamel (2003, 654-655) reason, with the help of economies of scale and scope suppliers can have more cost-efficient processes, which allows lower costs

and improved operational efficiency through outsourcing. Thus, suppliers can have better expertise in outsourced processes that enables improvements in performance and quality. Therefore, as specialized suppliers are more efficient, they can also gain cost savings in personnel training, and research and development activities, leading in improved productivity (Belcourt 2006, 271-272). More operational cost savings can be achieved in form of lower labour costs by outsourcing to countries that have comparative advantage regarding cheaper operations (Varadarajan 2009, 1169). Alexander & Young (1996, 116) conclude that these advantages add up so much value that suppliers can generate better service and lower costs to the buying organization while allowing the supplier to have a profit margin. Moreover, outsourcing also helps to cope with uncertainty, and capital formerly invested in insourced activity can be redirected to other activities where the return of investment is higher (Belcourt 2006, 272). Finally, outsourcing provides companies with better coverage and closeness to expanded markets with suppliers located all over the world (Weidenbaum 2005, 311-312).

Despite all the cost savings and other benefits, outsourcing adds complexity to a company's supply base, requiring close examination of transaction costs and SRM practices (Cousins 1999, 145). As Choi & Krause (2006, 638) warn, the more company decides to buy instead of make, the more dependent it becomes on its supply base. Thus, supplier selection should be a high priority in companies.

## 4.2 Supplier selection

As discussed, the trend of outsourcing has become increasingly popular and companies are more dependent on their supply bases, the direct and indirect consequences of poor decision making in supplier selection have become more critical (Chan, Kumar, Tiwari, Lau & Choy 2008, 3826). The criticality is highlighted by Ho, Xu & Dey (2010, 16), who point out companies are aiming to maintain long term partnerships with fewer suppliers that are more reliable. Yoon, Talluri, Yildiz & Ho (2018, 3636) consider supplier selection as a critical issue in SCM because it is connected to maintaining a competitive advantage. Finally, Ho, Dey & Bhattacharya (2015, 152) differentiate strategic supplier selection from the traditional

low-cost and one-off supplier selection. Long term, strategic partnerships aim to gaining insights for product development and resolving operational issues. This chapter focuses on strategic supplier selection, as it is more important.

The difference between product and supplier categories can be done with the help of the Kraljic matrix, as presented in Figure 5. Kraljic (1983, 110) defines that supply strategy depends on two factors, (1) the strategic importance of purchasing and their impact on profitability, and (2) the complexity of the supply market, i.e. supply scarcity, entry barriers, and market dominance by single/few suppliers. By assessing these variables, and the four categories they form, a company can determine which kind of strategy it needs to implement. Thus, the Kraljic matrix can also help determining the optimal supplier selection processes.

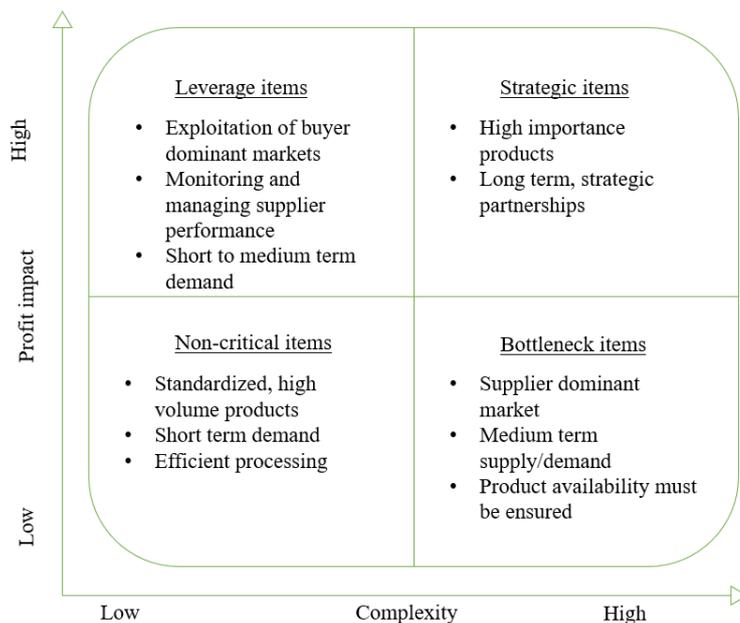


Figure 5. Kraljic matrix and category characteristics (Kraljic 1983).

Cox (2004, 352) links power and leverage situations between buyers and suppliers to different categories. While within non-critical items the parties are independent, suppliers have dominance over buyers within the bottleneck items. Buyer dominance is established with leverage items, and often in strategic category the parties are interdependent. The presented circumstances between the buyer and suppliers need to be recognized to develop

appropriateness in sourcing (Cox 2004, 351). Based on Cox (2004, 353) and Kraljic (1983, 112) with non-critical items, short-term market testing and maximization of value should be the focus. In leverage items, the buyer leverage should be exploited together with extensive operational focus and adaptations to the relationships. With bottleneck items, suppliers have dominance, and therefore buyers should focus on ensuring supply. Finally, with strategic items the aim should be to establish transparent operational long-term relationship where value is shared equally. As Bygballe & Persson (2015, 66) conclude, with segmentation and differentiation companies can assess purchasing situations and how to relate to suppliers. With these characteristics in mind, companies should be able to establish versatile supplier selection processes.

Amid, Ghodsypour & O'Brien (2009, 323) highlight that supplier selection requires multiple criteria decision making. It is affected by several conflicting factors and trade-offs between different criteria must be evaluated. However, as Nair, Jayaram & Das (2015, 6264) suggests, clear and aligned criteria help in the decision making, ensuring clear supplier roles, and predictability in outcomes. Therefore, there are two kinds of supplier selection problem, which are according to Ghodsypour & O'Brien (1998, 199-200) the following:

- 1) Supplier selection where all suppliers can satisfy the buying company's requirements
- 2) Supplier selection when no supplier can satisfy the buying company's total requirements

The authors continue that in scenario 1 the problem is to select which supplier is the best, but scenario 2 is more complex. In scenario 2 the buying company must assess how many suppliers it needs to satisfy all the requirements, which suppliers are the best, and how the purchases should be divided between the suppliers. For supplier selection, Ghodsypour & O'Brien (1998, 201) suggests a five-step approach:

- 1) Define the supply criteria

- 2) Calculate the weights for each criterion
- 3) Rate the alternative suppliers for each criterion
- 4) Calculate the overall score of each supplier
- 5) Decide the optimal amount of purchases for each supplier

The criteria and evaluation should include requirements of supplier capabilities in cost, quality, delivery, capacity flexibility, innovation, and others (Ghodsypour & O'Brien 1998, 199-200; Nair et al. 2015, 6264). However, Ho et al. (2010, 22) studied that price or cost is not the criterion companies are most interested in. Instead, quality and delivery were the two most popular criterion used for supplier performance before cost. This proves that the traditional single criterion cost-based approach is not optimal in global supplier selection, because other factors are more important.

Rating the supplier capabilities and performance should be done carefully considering how well they address multiple stakeholder interests (Nair et al. 2015, 6264). This is supported by Ho et al. (2015, 152), who suggests strategic supplier selection should involve internal stakeholders, such as manufacturing, finance, and others, and considerations about external stakeholders, such as government policies. Chan et al. (2008, 3825) highlights the importance of global supplier selection criteria, since it is more complex than domestic sourcing, it requires more critical analysis and more criteria. They stress the importance of assessing the political-economic situation, geographical location, infrastructure, performance history, and risk factors. Similarly, Yoon et al. (2018, 3657) suggests that risk mitigation strategies are important considerations together with supplier selection rather than considering these in isolation, because of conflicting goals.

#### 4.3 Supply base size

During and after selecting suppliers, companies should assess how big supply bases they want to build. The size of the supply base is a critical factor, affecting in many activities

within the company managing the supply base. Cousins (1999, 146) argue that large supply bases are inefficient. This is supported by Trent and Monczka (1999, 931), who state large supply bases are difficult to manage, and developing value adding activities is easier with fewer suppliers. They also add that reduced supply base is the key to have higher average supplier quality since no company would eliminate their best suppliers. Ogden & Carter (2008, 6) point out that large supply base enables lower pricing because either company switches to lower priced suppliers or higher priced suppliers are forced to lower their prices or provide additional services. However, the views of Trent & Monczka (1999) and Ogden & Carter (2008) are not against each other since quality and price rarely go hand in hand. However, as Ahtonen & Virolainen (2009, 268) and Berger et al. (2004, 14) note, traditionally companies have been advised to reduce their supply bases. This is supported by Cooper & Ellram (1993, 17) who suggests that the reduction of supply base is advised in order to be more closely integrated to suppliers. In addition to focusing on value adding activities, Ogden (2006, 34) and Cousins (1999, 143) studied that companies that reduce their supply bases enjoy several other benefits. These include increased quality of products and processes, decreased uncertainty and costs, more efficient resource utilization, and developed communication and information sharing. Thus, the overall competitiveness of a company is increased.

Corey (1978) state that company should examine two issues when deciding on the number of suppliers. If there are too many suppliers, a company could end up in a situation where it is not perceived as an important customer. However, Cooper & Ellram (1993, 17) argue that with several suppliers increased competition is favourable for the buying company. In addition, they continue that many suppliers spread the risks of shutdown if one supplier does not fulfil their obligations. Corey (1978) continues if there are too few suppliers, competition between the suppliers decrease. Similarly, Cousins (1999, 143) warns when there are small number of suppliers, companies can become too dependent on the relationships if they are not managed well enough. Then, companies are forced to increase the size of their supply base to mitigate the issue. Thus, companies should carefully assess their sourcing strategies that are reviewed in the next chapter.

#### 4.4 Sourcing strategies

As the use of fewer suppliers is traditionally encouraged, more closer supplier relationships are established and managed which aims to reduce the mentioned risks, as well as evolve and preserve relationships with those key suppliers (Lambert & Schwieterman 2012, 337). Hartley & Choi (1996, 37) and Bygballe & Persson (2015, 66) expand that supplier development and collaboration improve quality of products and processes, reduce cycle times, cut costs, and increase capacity. These long-term close relationships focus on lower total costs, compared to the lower prices of short-term opportunistic relationships (Cousins 1999, 144). To conclude, supplier involvement is seen as highly challenging but worth the efforts due to the notable benefits (Bygballe & Persson 2015, 66).

As discussed in chapter 1.5, there are several sourcing options to choose from when forming a supply base. When company uses only one supplier, it is either single sourcing or sole sourcing. As Ahtonen & Virolainen (2009, 268) note, single sourcing is favourable over sole sourcing since the sole supplier has a monopolistic power in the situation. Thus, sole sourcing can lead to increased prices, poor quality, and poor service levels if the relationship is overlooked by the buying company (Cousins 1999, 147). After voluntarily choosing a single supplier from a larger group, single sourcing is aiming to achieve the strategic partnership and shared benefits, which often is desired by companies, aiming to execute streamlined supply processes. However, the practices of single and sole sourcing expose the buying firm to greater risks of supply interruptions. (Yu et al. 2009, 790-791). To mitigate supply risks, dual sourcing or multiple sourcing can be useful instruments in dealing with supply continuity. These strategies aim to reduce the prices, or increase reliability (Yu et al. 2009, 79; Berger et al. 2004, 10). Ahtonen & Virolainen (2009, 268) suggests that parallel sourcing combines the benefits of single and multiple sourcing. It allows close relationships with suppliers, together with the competitive nature of multiple sourcing (Richardson 1993, 349).

Final consideration of a supply base strategies is the location of suppliers. As discussed earlier, suppliers and hybrid sourced activities can be domestic, from close-by countries or

distant countries. As Ahtonen & Virolainen (2009, 268) remark, many companies use both local and global suppliers. However, it is noted by many authors (e.g. Handfield et al. 2020; van Hoek 2020; Weidenbaum 2005; Choi & Krause 2006), many western companies have become dependent on global supply networks and especially on Asian suppliers. As Bygballe & Persson (2015, 77) present, cost pressures and increased competition turn companies to global suppliers. Scheuing (1989) adds that through global suppliers' companies can gain access to larger resources and better capabilities. However, supplier relationships are more difficult to manage because of geographical distance, language barriers and cultural differences (Bygballe & Persson 2015, 76). These are easier with local suppliers who also provide more reliable delivery, shorter delivery times and lower transportation costs (Scheuing 1989).

To conclude, firms are seeking to reduce their supply bases in order to develop more close relationships with suppliers. These relationships are more complex than short term opportunistic relationships that are usually associated with having many suppliers. In addition, it is agreed that closer relationships provide lower total costs. When it comes to cutting costs, western country firms often seek more competitive suppliers from developing countries, especially in Asia. However, reduced supply base is less flexible (Cousins 1999, 147), and as Hendricks et al. (2009, 244) and Chopra & Sodhi (2014, 74) note, many of these practices, including outsourcing, supply base reduction, and reliance on single sourcing, are major issues when dealing with supply disruptions.

#### 4.5 Supply base strategies

Since traditional supply base strategies are more vulnerable and prone to disruption, this chapter examines supply base strategies that aim to mitigate those risks. Recently, as COVID-19 has temporarily collapsed many supply chains, these strategies have become timely. Kähkönen et al. (2021, 2) suggests that COVID-19 pandemic will change SCM profoundly. Handfield et al. (2020, 1651) calls out that supply chain systems are driven by accountants focusing only on costs and not on risks. They continue (2020, 1655) that lowest total cost considerations should include increased risk of disruption and other factors that are

not traditionally included in the analysis. Thus, most managers only make small tweaks to traditional approaches and focus too much on price or landed costs rather than total costs, while they should consider more substantial changes.

Since the pandemic unfolded, many academics have focused on reshoring, especially the triggering effect it has had on the decision making, and the reconfiguring of supply bases (e.g. van Hoek & Dobrzykowski 2021; Barbieri et al. 2020; Strange 2020; van Hoek 2020). Initially, the reshoring initiatives aimed to shorten supply chains, making them less vulnerable to travel restrictions (Strange 2020, 461). However, as the situation has stabilized, we know that these restrictions play very little part in the decision making. Now, more the contemplations are more focused on logistics capacity, shortened delivery times, reduced risks (van Hoek & Dobrzykowski 2021) and overreliance on few suppliers or single sourcing (Lin et al. 2021, 19; van Hoek 2020, 349). In addition, reduced dependency on highly consolidated and geographically concentrated supply bases are desired (van Hoek & Dobrzykowski 2021, 695; Handfield et al. 2020, 1651). Gadde & Jonsson (2019, 8-9) concludes that reshoring can enhance supply responsiveness, decrease time to market and increase flexibility.

Barbieri et al. (2020, 134-135) demonstrate that the reshoring decision is highly dependent on the market segment and strategic competitiveness angle of companies. While reshoring might be difficult for companies that mainly compete with low prices, a company with advanced technology and high criticality for quality should be more open to the idea since they do not compete with price. Similarly, van Hoek & Dobrzykowski (2021, 695) noted that products with high value could be reshored. In addition, they continue that product weight and value play key roles in the decision making. Products that weight more or are bigger in volumes have higher logistics costs, so it might be beneficial to source from close to the home market, especially during the pandemic where logistics capacity is an issue. However, as these issues are most likely temporary, the implementation of reshoring might take too long to be beneficial.

Diversified supply base provides better resilience to supply chain disruptions. Firms with geographically centralized supply bases are more vulnerable to local disruptions such as natural disasters. (Strange 2020, 459). Barbieri et al. (2020, 133) capsulize that these supplier relocation issues are driven by the need to reduce the buying company's risk exposure. While COVID-19 restricts travel in many ways, the disruptive effects become more severe when the distance between buyer and supplier lengthens. Also, many firms have experienced shortages because foreign suppliers have favoured local customers. (Strange 2020, 460). Similarly, Hayakawa & Mukunoki (2021, 170) found out that negative effects of COVID-19 hurt less intra-continental trade in Asia. However, they argue that it was easier to mitigate negative supply chain disruptions. Chen et al. (2019, 337) implies that during disruptions companies in the same region can collaborate with each other to minimize the impact and shorten recovery times.

Since pandemics like COVID-19 are likely to impact the supply bases worldwide, more international diversification is called by Strange (2020, 463) and Lin et al. (2021, 19). Van Hoek & Dobrzykowski (2021, 693) explain that when the disruptions hit different locations during different times, it increases the probability of companies having functioning suppliers and they can switch orders between suppliers and therefore increase flexibility. Similarly, van Hoek (2020, 349) calls for moving away from single sourcing. This is supported by Lin et al. (2021, 19). They argue (2021, 4) that by maintaining a diverse supply base companies can avoid backlogging and failing to fulfil customer orders. Van Hoek (2020, 349-350) suggests that including nearshoring and domestic sourcing besides offshoring enables companies to response regional demands faster. This also reduces the dependency on a few global suppliers.

The three companies studied by van Hoek & Dobrzykowski (2021, 699) stated that reshoring is not the only move to make as they also seek other global sources in distant countries. These are time consuming processes, but the increased tariffs had companies to seek alternatives to Chinese sources before COVID-19. Thus, companies can accelerate existing development of new offshore supply sources to reduce dependency on Chinese suppliers. Local and nearshored sources were also in consideration because they offer advances in

logistic costs and delivery speed. These contemplations are supported by Handfield et al. (2020, 1651). Van Hoek & Dobrzykowski (2021, 693) also add that these reshoring activities can be done with existing suppliers in hybrid sourcing fashion since nearshoring allows companies to benefit from favourable trade agreements (e.g. US company sourcing from Mexico or European company sourcing from Turkey).

In addition, there are different things to consider when making strategic changes. Van Hoek & Dobrzykowski (2021, 694) suggests it takes different considerations and implementation when a company buys from an existing supplier and when they buy from new suppliers, therefore it is important to distinct these two approaches. Moreover, van Hoek (2020, 343) suggests that companies must find a balance between different supplier segments presented in the Kraljic matrix. He demonstrates that for bottleneck suppliers, companies should focus more on ensuring supply than on cost savings, and for strategic suppliers the emphasis should be on collaboration. In addition, reshoring decision is not just isolated decision on supply base, there are huge supplier networks behind the buyer-supplier dyad (van Hoek & Dobrzykowski 2021, 697), as presented earlier in Figure 3. Handfield et al. (2020, 1650) suggests setting up new sources is time consuming, as a new outsource partner in low-cost offshore country requires at least a five-year planning horizon. This includes supplier qualification, audits, start-up, quality certification, and ramp-up. Therefore, if these sources are searched only because of the pandemic, many of these considerations might lose relevance when supply normalizes.

Finally, as Strange (2020, 459) points out, having complex and diversified global supply bases compared to more simple and centralized supply base brings additional costs. These include higher transportation costs, extended delivery times, more demanding SRM and supplier development practices, and many more. Thus, having more resilience and better risk management is more expensive than traditional strategies where companies are dependent on Asian suppliers. This is supported by van Hoek (2020, 353), who calls for balancing a focus between costs and responsiveness and resilience. However, he continues that supply chain managers have not yet succeeded to move beyond costs efficiency focus. Lin et al. (2021, 3) argue companies with more diverse supply bases are better prepared for

future disruptions. Therefore, the aim of this thesis is to study if companies are going to change their supply base strategies because of COVID-19.

## 5. Moving forward

COVID-19 pandemic related supply disruptions have led to concerns how companies can ensure functioning supply chains. As presented in chapters 3 and 4, the functionality can be improved either with adaptations to supply base strategies or improving resilience in the supply chain. When it comes to supply base, companies can adapt the sources, locations, and number of its suppliers. With resilience, a company can cope disruptions with a wider set of tools. This chapter will reflect on the previous two chapters and contemplate how companies should move forward with these strategies during and after COVID-19.

When considering changes to supply base, managers should keep in mind Ogden's (2006, 36) suggestion that it is critical not to make too sudden changes to a supply base. Implementing reduction efforts over time allows the remaining suppliers to increase their capabilities and new suppliers to work out quality issues before providing larger volumes. Making too rapid changes to supply base usually means supply shortages or quality problems. Gradually phasing in and out suppliers may be the best approach. (Ogden 2006, 36). As noted by Cousins (1999, 153) supplier selection is much more difficult than reducing the number of suppliers. Thus, if a company runs into issues by reducing the supply base too rapidly, it might take a lot more time to fix the issue.

Table 3 presents the changes to supply bases proposed by scholars. Many scholars called for reducing dependency on suppliers and single sourcing. Supply diversification can be achieved two ways: either increasing insourcing and hybrid sourcing, or increasing the number of suppliers by implementing dual, parallel, or multiple sourcing. Supplier location contemplations concentrated mostly on how supply chains need restructuring. Diversification can be done by reshoring and nearshoring. Finally, also the benefits of regional supply chains were discussed by several authors, and proposed by some.

Table 3. Proposed supply base initiatives post COVID-19.

Activity	Authors
Increased dual, parallel & multiple sourcing	Tomlin 2009, Chopra & Sodhi 2014, Paul et al. 2021, Gereffi 2020, Ivanov 2020, Strange 2020, Lin et al. 2021, van Hoek 2020, van Hoek & Dobrzykowski 2021, Handfield 2020, Alicke et al. 2021
Increased insourcing	Tang 2006a, van Hoek & Dobrzykowski 2021, Lee 2021
Increased hybrid sourcing	van Hoek & Dobrzykowski 2021
Regionalizing supply chains	Chopra & Sodhi 2014, Hayakawa & Mukunoki 2021, Chen et al. 2021, Lin et al. 2021, Alicke et al. 2021
Reshoring	van Hoek & Dobrzykowski 2021, Barbieri et al. 2020, Strange 2020, van Hoek 2020
Nearshoring	Alicke et al. 2021, van Hoek & Dobrzykowski 2021, van Hoek 2020, Handfield et al. 2020
Diversified offshoring	van Hoek & Dobrzykowski 2021

However, selecting new suppliers could require years of work, and these efforts might be outdated by the time the pandemic is over. In addition, the several authors highlighted the costs of managing large supply bases. In addition, Trent & Monczka (1999, 935) argue that with a rationalized supply base improvements are achieved through developing supplier capabilities rather than switching between suppliers. Choi & Krause (2006, 643) argue that in general increased supply base complexity, consisting of number of suppliers, differentiation between suppliers, and interrelationships between suppliers, increases also supply risks. However, reducing the complexity is not straightforward, as reducing the number of suppliers too much might also increase risks (Choi & Krause 2006, 649). Thus, there is a fine line when companies are trying to find a balance between the optimal number of suppliers and their locations.

While the idea behind using fewer, more reliable suppliers is dominant in today's organizations, the pandemic has revealed its problems. No matter how reliable supplier, they cannot be immune to severe disruptions. Therefore, companies should take actions to cover from these risks using also other measures. As Kahiluoto et al. (2020, 286) put it, companies must move beyond supplier locations and size of supply bases. This can be achieved by recognizing resilience.

Table 4 presents the resilience improvements suggested in the literature. Logistical suggestions were to increase inventories to buffer disruption and increasing logistical flexibility by adding the use of different routes and transportation modes. Then, supplier development and SRM practices were also suggested by many authors. These aim to increase supplier responsiveness during disruptions. Also changing supplier and payment terms in favor of suppliers were presented. This increases the financial position of suppliers, and possibly helps buyers to ensure supply during difficult times. Also, reactivity to shifting production from disrupted areas were presented by many. This could be done either by shifting production between suppliers, or by shifting production from suppliers back to inhouse. Similar approach is to have back-up suppliers in case of need to ramp up production. Customer demand was mentioned as an important coping strategy to increase the agility of a supply chain. And finally, by investing in IT systems, companies can achieve responsiveness that is key element of resilience.

Table 4. Proposed supply chain resilience improvements post COVID-19.

Activity	Authors
Increased inventory	Tomlin 2006, Rezapour et al. 2017, Handfield et al. 2020, van Hoek & Dobrzykowski 2021, Alicke et al. 2021
Increased logistic options	Tomlin 2006, Tang 2006a, Ivanov et al. 2017
Supplier development & SRM	Kahiluoto et al. 2020, Chowdhury & Quaddus 2016, Lee 2021, Chen et al. 2019, van Hoek 2020, Paul et al. 2021, Kähkönen et al. 2021
Enhancing supplier and payment terms	van Hoek & Dobrzykowski 2021
Shifting production locations	Tang 2006a, Lee 2021, Tomlin 2006, van Hoek & Dobrzykowski 2021
Back-up suppliers	Ivanov et al. 2017, Tang 2006a, Alicke et al. 2021
Increased focus on demand	van Hoek 2020, Kähkönen et al. 2021
IT systems	Chopra & Sodhi 2014, Lee 2021, Chen et al. 2019, Kähkönen et al. 2021, Ivanov 2020, Paul et al. 2021

All in all, with these supply base improvements and resilience activities companies can cope with disruptive events better than most have been able during the COVID-19 pandemic. Not all strategies can and should be implemented at once, but the purpose of this chapter was to gather the key activities covered in the literature review of this thesis and provide a

foundation for the survey this thesis uses to conduct the study. Next chapter will take a look at the methodology of the mentioned thesis study.

## 6. Methodology

The purpose of this chapter is to review and justify the empirical study of the thesis. The research instrument, or the survey, can be found as Appendix 1. The aim of the empirical survey was to compare the results with previously presented theory about supply base strategies and supply chain resilience. The study was conducted with quantitative research methods that according to Punch (2003, 2) studies how variables are distributed between the responses, and the relationship between variables. The reason quantitative methodology was chosen over qualitative is that it enables larger sample of responses and straightforward data collection (Saunders et al. 2016, 443). The questionnaire was distributed online to the targeted companies which in this case are Finnish companies with global supply networks. The data was collected with survey tool Webropol. The survey was conducted between late January and early March in 2022. The sample size of the survey is presented in Table 5. The survey was sent to 41 companies operating in Finland. 14 valid responses were received, giving a response rate of 34,1 %.

Table 5. Sample size of the survey.

Survey answered	n	%
Yes	14	34,1
No	27	65,9
Total	41	100

The survey was conducted as a self-completed questionnaire, that according to Saunders et al. (2016, 440) are completed by the respondents individually. The answers were given on a five-point Likert scale. Each variable and therefore questions were based on the research questions and conceptual framework of this thesis, as presented in previous chapters. The survey was structured as follows: the first section had 4 questions about background information about the companies. Next section had 6 questions about the companies' situation before the COVID-19 pandemic. These are reviewed later in chapter 7.1. Third section had 9 questions on supply chain resilience post COVID-19, reviewed later in chapter

7.2. Finally, the fourth section had total of 16 questions about companies' supply bases post COVID-19. These are studied in chapter 7.3. The structure of the survey is presented in Table 6.

Table 6. Structure of the survey.

Theme	Number of questions
Background information	4
Situation before COVID-19	6
Supply chain resilience post COVID-19	9
Supply base post COVID-19	16
Total	35

The purpose of the first section was to gather information about the participating companies. The second section was assembled to study how well-prepared companies were for major supply disruption, more specifically COVID-19. Finally, the third and fourth sections were constructed to serve the purpose of this study that focused on supply base and resilience improvements post COVID-19. Questions in sections 2 through 4 were developed based on the numerous authors that were reviewed in previous chapters. Most notably Tables 3 and 4 in chapter 5 about proposed improvements on supply base strategies and resilience efforts were the inspiration of the survey.

Table 7. Company size and revenue.

Company size	n	%
1-10 employees	0	0
11-50 employees	0	0
51-250 employees	0	0
251- employees	14	100
Total	14	100
Company revenue	n	%
Less than 2 million €	0	0
2-10 million €	0	0
11-50 million €	0	0
Over 50 million €	14	100
Total	14	100

Interestingly and slightly unexpectedly, none of the respondents represented micro-, small-, and medium-sized companies. As presented in Table 7 above, all responding companies had more than 250 employees and turnover above 50 million euros. Thus, all responding companies represent mid- and large-cap companies. Table 8 presents the different industries the participating companies represent. Deviation between industries was quite noticeable, as most represented industry was technology with three companies. Forestry and machinery had both two companies, and consumer goods, electronics, food and beverages, and metal products each was represented by one company. Three companies did not fall into none of the above-mentioned industries. In addition, 10 of the 14 companies were manufacturing companies. This study will later in chapter 7 analyze how the answers between manufacturing companies and non-manufacturing companies compare to each other.

Table 8. Represented industries.

Company industry	n	%
Consumer goods	1	7,1
Electronics	1	7,1
Food and beverages	1	7,1
Forestry	2	14,3
Machinery	2	14,3
Metal products	1	7,1
Technology	3	21,4
Other	3	21,4
Total	14	100

According to Yin (2009, 40), research reliability is the factor that allows the same study to be repeated twice using the same procedures and end up with the same results, while validity portray the ability of the chosen research method to measure the focused concepts and causal relationships in the study. As Kähkönen (2011, 38) points out, the evaluation of reliability and validity are important in academic research. The main research question of this thesis stated that the companies participating in the study must have global supply network. Therefore, as one of the background information questions, the companies were asked if they had one. As Table 9 shows, all the companies had global supply chains.

Table 9. Does the company have a global supply chain.

Does the company have a global supply chain	n	%
Yes	14	100
No	0	0
Total	14	100

Another validating aspect of the study is the positions the participating representatives hold in their companies. This information was not asked in the survey but gathered through sources such as emails and LinkedIn. Consequently, the respondents worked in positions such as Supply Chain Analyst, Supply Chain Coordinator, Technical Team Leader, Production Planner, Logistics Coordinator, Logistics Director, Purchaser, and Purchasing Manager. Thus, it is safe to say that the participants are familiar with the concepts of this study.

The sample size of this study allows to consider the result reliable. However, as there are 14 participants, the confidence interval of the answers may vary. In addition, the results and averages of answers should be considered more directive than rigorous. Moreover, this approach should be carried in mind especially about the comparisons between manufacturing and other companies. Finally, the survey was conducted anonymously in order to provide more truthful and thus reliable answers. The answers were only identified to create the comparison groups for the study. None of the answers were studied or presented individually. Next chapter will focus on the analysis of the answers to this study.

## 7. Analysis of results

This chapter will review the results of the empirical study. Each section of the survey will be reviewed in their own chapters question by question. Answers are presented in three groups: (1) all participating companies, including 14 answers, (2) manufacturing companies, including 10 answers, and (3) other companies, including the rest 4 answers. At the end of each chapter, a recap table of the mean answers within each group are presented. Chapter 7.1 will review questions about situation before COVID-19, chapter 7.2 questions about supply chain resilience post COVID-19, and chapter 7.3 questions about supply base strategies post COVID-19. As mentioned, the survey can be found as Appendix 1. Each answer was given on a 5-point Likert-scale, where 1 = not at all, and 5 = to a great extent.

### 7.1 Situation before COVID-19

The purpose of the second section of the survey was to weigh how well companies were prepared for disruptive risks before COVID-19 pandemic started. There were total of six questions, one measuring the overall preparedness, four questions measuring the initial causes that are the base for such preparedness, and one question measuring the COVID-19 related issues on supply chains. Table 10 presents each question, as well as the mean answers and standard deviation (SD) for each answer group.

First question of the section measured how well companies were prepared for supply disruptions. As presented in Table 10, the mean answer to the question was 3,29, implying that all the studied companies were fairly well prepared. However, while the mean answer for other companies was 3,75, to manufacturing companies it was notably lower with 3,10, suggesting that manufacturing companies might have had more issues coping with the supply continuity since COVID-19. In addition, manufacturing companies had standard deviation (SD) of 0,88 compared to SD of 0,50 for others. This suggests the manufacturing companies had more variety to their preparedness.

Table 10. Situation before COVID-19 answers.

	Total	Manufacturing	Others
<b>We were well prepared for supply disruptions</b>			
Mean	3,29	3,10	3,75
Standard deviation	0,83	0,88	0,50
<b>We were too dependent on offshore/distant suppliers</b>			
Mean	3,14	3,40	2,50
Standard deviation	1,03	0,97	1,00
<b>We were too dependent on single sourcing</b>			
Mean	2,93	3,20	2,25
Standard deviation	1,33	1,40	0,96
<b>Complex relationships with key suppliers set our supply chain to vulnerabilities</b>			
Mean	2,29	2,20	2,50
Standard deviation	0,99	1,03	1,00
<b>COVID-19 pandemic related issues have affected our supply chain</b>			
Mean	3,86	4,00	3,50
Standard deviation	0,95	1,05	0,58
<b>Reluctancy of mitigating supply disruptions based on cost-risk ratio</b>			
Mean	3,14	3,10	3,25
Standard deviation	1,03	1,10	0,96

Second question in Table 10 measured dependency on offshore suppliers. As suggested in the literature review, having distant suppliers during supply disruptions can cause noticeable harm to supply chains. With COVID-19, especially companies with high dependency on Chinese suppliers could have experienced supply disruptions. Mean answer to the question was 3,14, indicating somewhat undesirable dependency on offshore suppliers. Manufacturing companies were clearly more dependent on them with mean answer 3,40 compared to other companies' mean answer of 2,50. The difference is quite radical, which can be seen as one of the reasons why manufacturing companies felt less prepared for supply disruptions than the other four companies. SD of answers in each group is around 1,00, suggesting some variance between companies dependencies.

Third question in Table 10 measured dependency on single sourcing. In the literature review it was discussed that single sourcing can expose companies supply chains to disruptions when individual key suppliers fail to meet the demand. Again, manufacturing companies had far worse mean answer with 3,20 than other participating companies with 2,25. This also

indicates why manufacturing companies felt less prepared for supply disruptions. It should be noted that the SD for manufacturing companies was 1,40 and for others 0,96. This implies big variance in answers between manufacturing companies, where others were much too dependent on single suppliers while others did not have the same issue.

When measuring complex relationships with key suppliers as a risk for supply chain vulnerabilities, most companies did not find complex relationships as a concern. The mean answer was 2,29 and SD for each group around 1,00. Manufacturing companies' mean answer was 2,20, lower than others' 2,50. It seems that manufacturing companies consider themselves slightly more skilled at maintaining relationships with key suppliers. This seems natural when they also consider themselves more dependent on them, and single and offshore sourcing are sources of greater supply risks.

Fifth question of the section measured how much COVID-19 related issues has affected supply chains. As discussed in the earlier chapters, almost no company have been able to avoid the consequences of the pandemic. However, the severity of the impact can vary. For the whole sample size mean answer was 3,86, for manufacturing companies 4,00, and for others 3,50. Manufacturing companies again have had it slightly worse than others, which can be explained with their dependency on offshore and single sourcing. Of course, also other factors such as logistical issues and availability of raw materials and components can influence on the experiences. However, also non-manufacturing companies have notably had issues because of COVID-19. SD for manufacturing companies was 1,05 and for others only 0,58. This implies more variance in answers between manufacturing companies and more coherent views for other companies. It is notable that there was also more variance in preparedness for supply disruptions with manufacturing companies than others, somewhat explaining the difference within question five.

The final question of section 2 aimed to measure the hesitancy of companies implementing risk management activities due to their cost-risk ratio. As described in the literature review, many risk management activities can be costly while disruptive events are rare. Since many companies operate their supply chains with substantial cost focus, this can lead to situation

where companies might be hesitant to invest in expensive risk averse strategies. While the mean answer was 3,14, manufacturing companies' mean was 3,10 and other's 3,25, indicating that manufacturing companies were more risk averse, which is somewhat inconsistent with previous questions. SD was around 1,00 for each group indicating somewhat of variance in the matter.

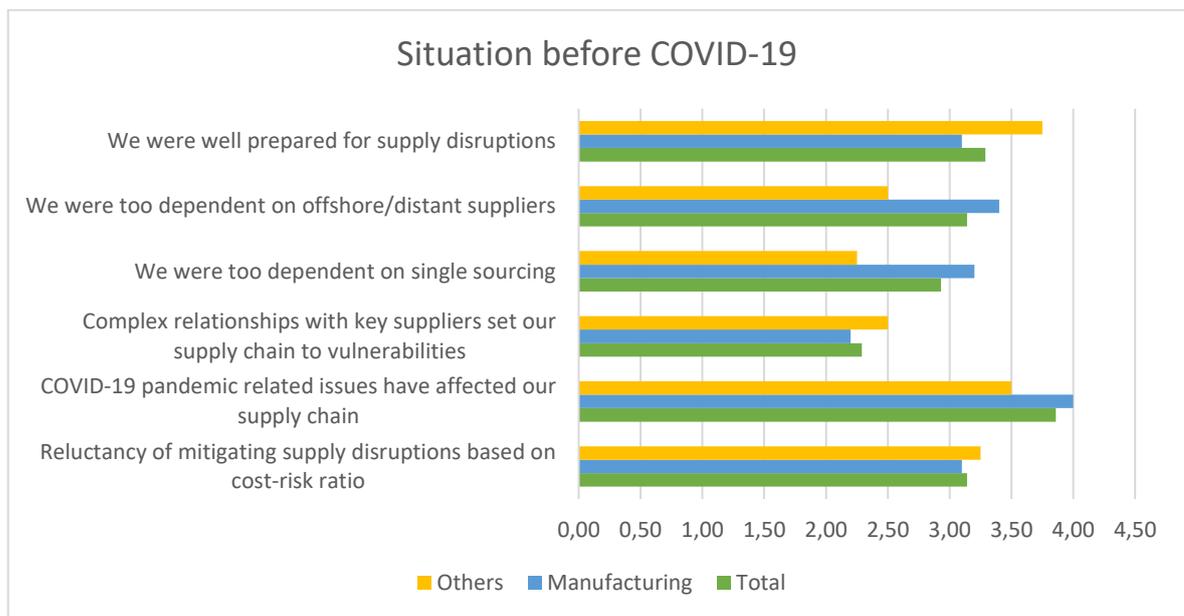


Figure 6. Mean answers between groups.

Finally, Figure 6 presents the mean answers within each group for the questions in the second section of the survey. With mean answer of 3,86, companies' supply chains were clearly affected by the COVID-19 pandemic. The main reasons seemed to be reluctancy to mitigate supply disruptions because of high costs, and dependency on offshore suppliers and single sourcing. Next chapters will study what changes companies are making due to COVID-19.

## 7.2 Supply chain resilience post COVID-19

This chapter focuses on the third section of the survey. It studied nine resilience approaches and how attractive they are post COVID-19. These included logistical, SRM, IT, and some

general SCM activities. Table 11 presents each question, as well as the mean answers and SD for each answer group.

Table 11. Supply chain resilience post COVID-19.

	Total	Manufacturing	Others
<b>We carry extra inventory to buffer disruption</b>			
Mean	3,57	3,60	3,50
Standard deviation	1,22	1,26	1,29
<b>We have increased supplier collaboration to enhance supplier responsiveness</b>			
Mean	3,79	4,00	3,25
Standard deviation	1,05	1,05	0,96
<b>We shift production between locations to avoid disruption</b>			
Mean	2,86	2,80	3,00
Standard deviation	1,29	1,40	1,15
<b>We developed new back-up suppliers</b>			
Mean	2,93	2,70	3,50
Standard deviation	1,07	1,06	1,00
<b>We utilize IT/data for screening disruptions and enhancing reactivity</b>			
Mean	3,57	3,70	3,25
Standard deviation	0,94	0,95	0,96
<b>We use alternative logistic modes/routes improve our resilience</b>			
Mean	3,14	3,50	2,25
Standard deviation	1,23	0,97	1,50
<b>We aim to reduce lead times</b>			
Mean	3,46	3,67	3,00
Standard deviation	1,13	1,22	0,82
<b>We have changed supplier and/or payment terms in favor of suppliers to gain trust and priority</b>			
Mean	2,50	2,60	2,25
Standard deviation	1,09	1,07	1,26
<b>We have increased focus on demand forecasting</b>			
Mean	4,20	4,20	3,25
Standard deviation	1,00	0,92	0,96

The first question of Table 11 measured if companies are going to carry extra inventory to buffer disruptions. With mean answer of 3,57, it was one of the most popular approaches in the study. Both manufacturing (mean of 3,60) and other (mean of 3,50) companies were quite close to each other in their answers, but with SD of 1,29 there was somewhat of deviation between the answers within both groups. As discussed earlier, extra inventory is a

secure way of counter unpredictable supply. On the downside, it increases fixed costs of companies.

Second question measured if companies will increase supplier collaboration to enhance supplier responsiveness. Mean answer to this question was 3,79, suggesting also increased supplier collaboration to be one of the most planned activities for the participating companies. However, manufacturing companies' mean was 4,00 while other companies only had mean of 3,25. This suggests that manufacturing companies are going to utilize supplier collaboration more than others. SD for both groups were around 1,00, implying some variance between answers.

The next two questions about resilience approaches in Table 11 were about shifting production between locations to avoid disruptions and developing new back-up suppliers. As the former had mean answer of 2,86 and latter had mean of 2,93, these were among the least approached resilience activities. The most notable finding from these questions were that other companies were fairly more interested in developing back-up suppliers with mean answer of 3,50 compared to manufacturing companies (mean of 2,70). This was one of the rare occasions that other companies had more interest in activities compared to manufacturing companies.

Fifth question studied how much companies are going to utilize IT/data for screening disruptions and enhancing reactivity. With mean answer of 3,57 it was again one of the most popular activities. Manufacturing companies were slightly more interested in it with mean of 3,70 while other companies had mean of 3,25. The SD for this question was 0,94 with only 0,02 difference between the two groups.

Sixth questions measured how much alternative logistic modes and routes improve resilience. Overall mean answer was 3,14, but again manufacturing companies had much higher average with 3,50 compared to others with mean of 2,25. However, other companies had SD of 1,50 which suggests remarkable variance between answers in the group. Overall,

alternative logistical were found to improve resilience somewhat well, and based on the answers manufacturing companies could utilize them more.

Question seven in Table 11 measured if companies aim to reduce lead times. The idea behind shorter lead times is that the supply chain and whole process becomes shorter, making it less vulnerable to disruptions. With mean answer of 3,46 it was fairly popular approach. Again, manufacturing companies had higher mean answer compared to others (3,67 vs. 3,00), implying more interest in shortening lead times in manufacturing. However, SD for manufacturing companies was notably higher with 1,22 than with others (0,82), suggesting more variance in manufacturing companies' answers.

Next question measured if companies have changed supplier and/or payment terms in favor of suppliers to gain trust and priority. With mean answer of 2,50 it was the least interesting resilience approach among the participating companies. This was followed by the last and most popular resilience approach in question nine of Table 11. Increased focus on demand forecasting had mean answer of 4,20 and SD of 1,00. Again, manufacturing companies had way more interest in the activity with mean of 4,20 compared to other companies mean of 3.25. The idea behind increased demand focus is to make supply chains more agile and sensitive to changes in demand.

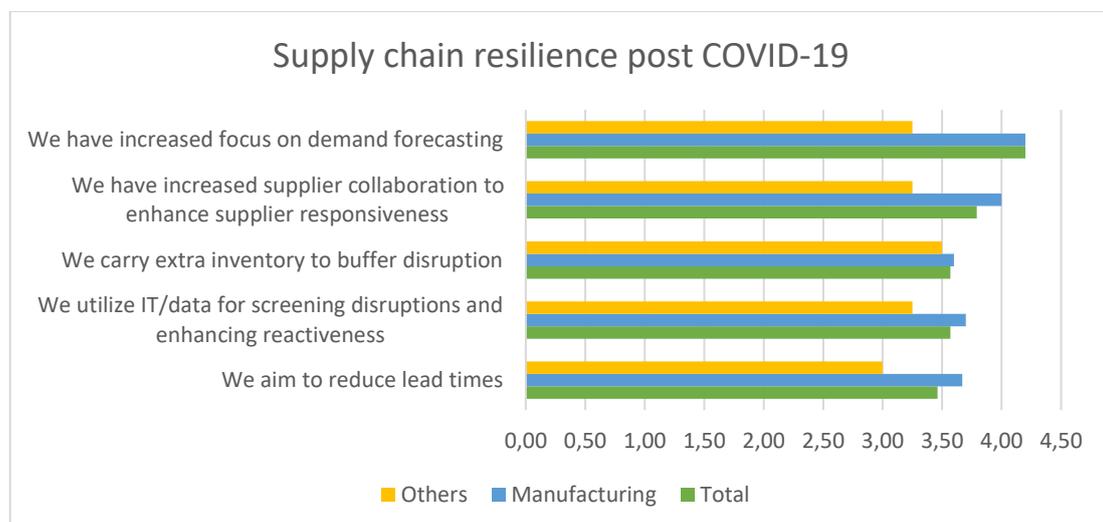


Figure 7. Most popular supply chain resilience approaches.

To conclude chapter 7.2, Figure 7 presents five of the most popular resilience approaches among the participating companies. What is notable from the results, manufacturing companies scored remarkably higher mean answers in four questions out of the five popular approaches. This could imply that supply chain resilience is more attractive in manufacturing environment. Overall, it was found that resilience is well desired by both answer groups as it enables sustaining operations during disruptions and improves performance under normal circumstances.

### 7.3 Supply base post COVID-19

The purpose of the fourth and final section of the survey was to measure what changes companies have made on their supply bases due to COVID-19. There were total of sixteen questions, measuring subjects such as source of supply, location of the supply base, and the number of suppliers used. Due to large number of questions in this section, the answers are presented in two separate tables. Table 12 presents the first half of the questions, as well as the mean answers and SD for each answer group.

The first two questions presented in Table 12 measured if companies are going to increase insourcing or hybrid sourcing. Interestingly, plans to increase hybrid sourcing (mean of 2,71) were more popular than insourcing plans (mean of 2,36). Insourcing plans were quite similar between the two groups, but other than manufacturing companies had significant variation in their plans with SD of 1,50. Increase of hybrid sourcing was remarkably more desired by manufacturing companies (mean of 3,10) than by others (mean of 1,75). In addition, manufacturing companies had quite similar approach to hybrid sourcing with SD of 0,57 compared others' SD of 0,96, which indicates different approaches among the group.

The next few questions focused on the location of suppliers. Third question of Table 12 measured if companies aim to increase geographical diversification of their suppliers to reduce dependency on highly concentrated supply bases. However, with mean answer of 2,57, companies were not very excited about geographical diversification. Of course, there was no background study if the participants had already widespread their suppliers. With

0,94 SD there is some deviation between answers, but for the most part geographical diversification was not an attractive activity.

Table 12. Supply base post COVID-19 (1/2).

We (including subsidiaries) aim to increase insourcing	Total	Manufacturing	Others
Mean	2,36	2,40	2,25
Standard deviation	0,93	0,70	1,50
We are going to increase hybrid sourcing			
Mean	2,71	3,10	1,75
Standard deviation	0,91	0,57	0,96
We aim to reduce dependency on highly concentrated supply base by increasing geographical diversification of suppliers			
Mean	2,57	2,70	2,25
Standard deviation	0,94	0,82	1,26
We aim to reduce logistical issues by having more close-by suppliers			
Mean	3,29	3,40	3,00
Standard deviation	1,14	1,07	1,41
“Made In China/Finland/etc.” labels affect our supply base decision making			
Mean	2,50	2,40	2,75
Standard deviation	1,09	0,97	1,50
We aim to increase reshoring			
Mean	1,93	2,20	1,25
Standard deviation	0,73	0,63	0,50
We aim to increase nearshoring			
Mean	2,64	3,10	1,50
Standard deviation	1,01	0,74	0,58
We aim to use of several regional supply chains instead of one global supply chain			
Mean	3,00	2,90	3,25
Standard deviation	1,18	1,29	0,96

As logistical bottlenecks and container shortages increased due to COVID-19, it was surveyed if companies plan to have more close-by suppliers to avoid logistical issues. It was one of the most popular supply base strategies with mean of 3,29. Manufacturing companies (mean of 3,40) were slightly more interested than others (mean of 3,00). SD of others was 1,41, indicating different approaches to the issue, while manufacturing companies had slightly more coherent approach with SD of 1,07 but still some deviation in their plans. On the other end of popularity, fifth question of Table 12 studied if production location of goods

affects companies' supply base decision making. With mean answer of 2,50, it did not seem like a critical factor. SD was 1,09, which implies that some companies had more weight on this criterion.

Next two questions in Table 12 measured two of the most discussed activities due to COVID-19, reshoring and nearshoring. They allow shorter supply chains, better logistical solutions, shortened delivery times and reduced risks, but those are long processes leading to increased supply costs. Both reshoring and nearshoring were significantly more popular with manufacturing companies than with others. Reshoring was by far less attractive option with mean of 1,93 than nearshoring with mean of 2,64. Companies were more coherent with refraining from reshoring with SD of 0,73, than about nearshoring (SD 1,01). Nearshoring plans were surprisingly popular with manufacturing companies (mean of 3,10), but other companies did not find it attractive with mean of 1,50 and 0,58 SD. The popularity of nearshoring over reshoring was predicted in the literature review due to lower costs.

Final question of Table 12 measure the willingness to use of several regional supply chains instead of one global supply chain. Interestingly, it was quite popular plan with mean of 3,00. Both manufacturing and other companies had quite similar approaches, but the deviation of answers was somewhat large with SD of 1,18. This implies that some companies had serious intentions to use regional supply chains, and others not so much. Regional supply chains allow diversified supply bases, closeness to final customers, and reduced transportation costs, but they also come with additional managing costs.

Table 13 presents the final questions of the empirical study. These questions focus on number of suppliers, supply base diversification, and other strategies regarding supply bases. The first question measured if companies aim to reduce dependency on highly concentrated supply base by increasing the number of suppliers. With mean answer of 2,86, SD of 1,10, and no major difference in answers between the two groups, companies seem to be serene with concentrated supply bases. However, increasing the number of suppliers requires more managing which could restrain interest in this method.

Table 13. Supply base post COVID-19 (2/2).

	Total	Manufacturing	Others
We aim to reduce dependency on highly concentrated supply base by increasing the number of suppliers			
Mean	2,86	2,90	2,75
Standard deviation	1,10	1,10	1,26
We aim to increase dual sourcing			
Mean	2,71	2,90	2,25
Standard deviation	0,99	0,88	1,26
We aim to increase parallel sourcing			
Mean	2,64	2,90	2,00
Standard deviation	1,01	0,99	0,82
We aim to increase multiple sourcing			
Mean	2,86	3,00	2,50
Standard deviation	1,23	1,25	1,29
Highly consolidated and geographically concentrated supply base is desired based on cost effectiveness			
Mean	3,29	3,40	3,00
Standard deviation	1,14	0,97	1,63
More diversified supply chain reduces our risks			
Mean	3,36	3,70	2,50
Standard deviation	1,15	1,06	1,00
We differentiate our supplier strategies between product categories			
Mean	2,93	3,00	2,75
Standard deviation	1,33	1,41	1,26
Digitalization driven supply chain visibility efforts affects our supplier selection			
Mean	3,36	3,10	4,00
Standard deviation	1,01	0,99	0,82

The next three questions measured companies' interest in dual, parallel, and multiple sourcing. With mean answer of 2,64 and SD of 0,99, parallel sourcing was the least tempting sourcing method. Dual sourcing gained slightly more interest with mean answer of 2,71 and SD of 0,99. Finally, multiple sourcing had mean answer of 2,86 and SD of 1,23. With multiple sourcing the SD implies that there was slightly more variance within the answers than in the other two sourcing methods. What is notable from all of the three questions, manufacturing companies scored higher mean answers for each, ranging from 0,50 difference in multiple sourcing to 0,90 difference in parallel sourcing. Thus, it seems manufacturing companies could be aiming to increase all of the methods slightly, but other companies are more hesitant especially regarding dual and parallel sourcing.

Fifth question of Table 13 measured if highly consolidated and geographically concentrated supply base is desired based on cost effectiveness. With mean answer of 3,29 this statement seems to be on point. Especially manufacturing companies (mean of 3,40) were more into this concept. However, mean for other companies was 3,00, but with SD of 1,63, implying great variance between answers in this group. Interestingly, next question measured if more diversified supply chain reduces the risks of companies. Mean answer to this question was 3,36, which is quite remarkable since companies recognize the importance of supply base diversification, but still desires concentrated supply bases as the previous question reveals. Especially manufacturing companies had much higher mean answer with 3,70 compared to 2,50 of other companies, indicating that diversified supply bases are exposing manufacturing companies to noticeably higher risks than other companies. Like in many other questions, with SD of 1,15, there was somewhat of variance between the answers.

Sixth question in Table 13 measured how much companies differentiate their supplier strategies between product categories. With mean answer of 2,93 and no significant difference between groups, it could be seen that companies are going to do it to a decent extent. However, SD for this question was 1,33, indicating some variance between answers. In this light, it could be that companies with more complex and specific products could utilize this strategy more than others.

Finally, the last question of the empirical study measured how much digitalization driven supply chain visibility efforts affects supplier selection. With mean answer of 3,36 this was the most popular activity regarding supply base strategies. Also, notable that other than manufacturing companies mean answer was 4,00 compared to 3,10 of manufacturing companies, highlighting a great difference in favor of other companies. In addition, other companies had slightly lower SD with 0,82, which indicates that they were more in consensus with their answers as a group.

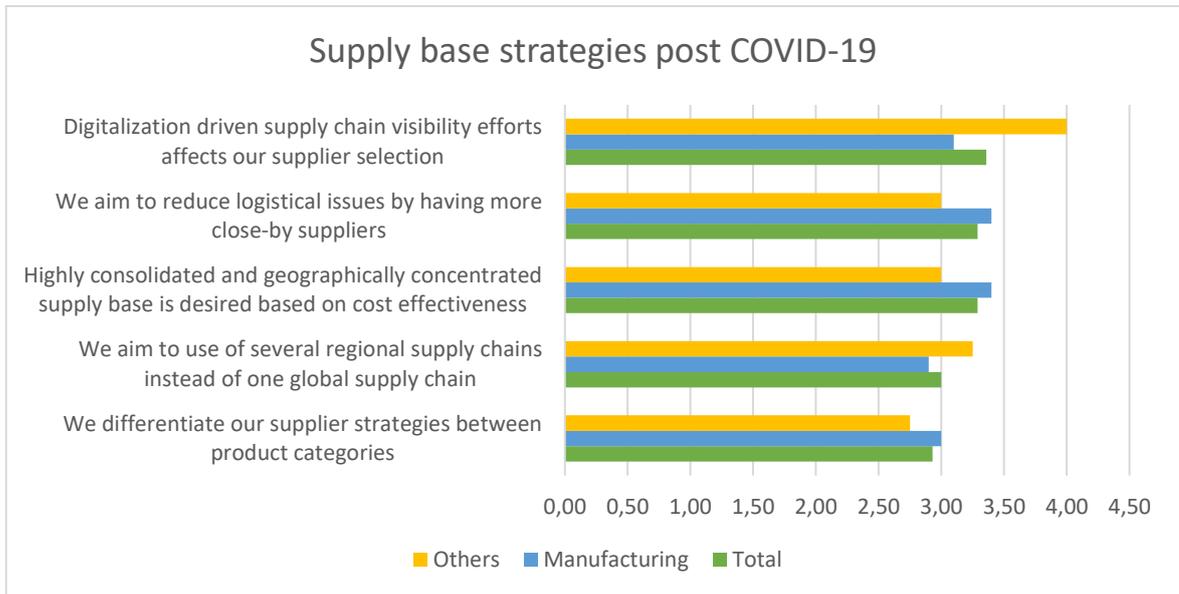


Figure 8. Most popular supply base strategies.

To conclude, Figure 8 presents the most popular supply base strategies found in the empirical study. From the results it is clear that consolidation of suppliers is desired to reduce logistical issues and costs. Interestingly, having several regional supply chains could be a solution to these aspirations while reducing the risk of disruptions. While other companies were more interested in digitalization driven supplier selection, the final section of the study was characterised by that manufacturing companies were more keen to invest in many strategies such as hybrid sourcing, nearshoring, and increasing the number of suppliers.

## 8. Discussion

The purpose of this chapter is to compare the findings of the empirical study to the literature review in chapters 2-5. New key findings and findings that support the literature review are highlighted. Similarly to the previous chapter, chapter 8.1 will discuss about situation before COVID-19, chapter 8.2 about supply chain resilience post COVID-19, and chapter 8.3 about supply bases post COVID-19.

### 8.1 Situation before COVID-19

What is notable from the second section of the survey, companies were decently prepared for supply disruptions. However, COVID-19 related issues still affected their supply chains greatly. As many scholars (e.g. Handfield et al. 2020; Lin et al. 2021; van Hoek & Dobrzykowski 2021) suggested, COVID-19 has had an unprecedented impact on supply chains. Overall, the empirical study found out that manufacturing companies were less prepared for the pandemic, and slightly more affected by it.

As Kähkönen et al. (2021, 15) argued, relationship management with key suppliers is essential preparedness to being able to respond to disruptions. In the empirical study manufacturing companies considered to have moderately better customer relationship management with key suppliers and more willing attitude to mitigate risks despite the costs, but they still suffered from worse consequences from COVID-19 disruptions. However, the differences in answers between the two groups were too minor to prove any inconsistencies between the findings of the empirical study and Kähkönen et al. (2021).

Manufacturing companies also scored notably higher averages on questions about dependency on offshore suppliers and single sourcing, which can be seen as main reasons for difference to cope with disruptive events of the pandemic. This is in line with the

literature review (e.g. Handfield et al. 2020, 1650-1651; Quélin & Duhamel 2003, 654-655; Varadarajan 2009, 1169), as offshore suppliers and single sourcing are often associated with lower costs, but exposing supply chains to more disruptions.

Finally, it was measured that companies are quite reluctant to invest in mitigating supply disruptions because of high costs. Also Tang (2006a, 34) and Rezapour et al. (2017, 1033) argued many companies are redundant to use costly strategies for mitigating disruptions that might not happen. Thus, this should be kept in mind when assessing the changes companies are going to make to their SCM practices.

## 8.2 Supply chain resilience post COVID-19

Among the least popular resilience approaches were developing back-up suppliers and changing supplier and/or payment terms in favor of suppliers to gain trust and priority. As Ogden (2006, 36) and Cousins (1999, 153) argued, developing new suppliers is time and resource committing. Thus, the more popular activities are more easily implemented. When it comes to changing supplier and/or payment terms, Handfield et al. (2020, 1651) called out companies focusing only on costs, which could explain the low interest.

Carrying extra inventory was one of the most popular resilience approaches in the empirical study and fairly equal among the two groups. As Tomlin (2006, 648) and Rezapour et al. (2017, 1033) studied, it is great way to mitigate disruption and counter unpredictable supply and demand. Van Hoek & Dobrzykowski (2021, 693) named inventory management to be a good way to ensure product availability. Traditionally, extra inventory is seen as excessive fixed costs, but the authors argue focus on inventory could be cheaper than modifying supply base. This is implied by the empirical findings of this study as extra inventory was more popular than any of the supply base strategies.

Increased supplier collaboration was found to be one of the most planned activities for the participating companies. It was also suggested that manufacturing companies are going to utilize supplier collaboration more than others. In addition to the empirical study, the importance of SRM was highlighted by multiple authors (Paul et al. 2021, 325-326; Kahiluoto et al. 2020, 275; Chowdhury & Quaddus 2016, 722; Lee 2021, 176; Kähkönen et al. 2021, 15) since SRM practices are key to gain visibility throughout the supply network and to improving collaboration within the supply chain. Chen et al. (2019, 340) found out collaboration to have a positive effect on supply chain recovery ability. While the reasoning behind answers in quantitative study are left out, these previous researches should suggest the aim of companies.

Similarly to supplier collaboration, utilizing IT and data for screening disruptions and enhancing reactivity was one of the popular approaches. Ivanov (2020, 11), Paul et al. (2021, 325), Chopra & Sodhi (2014, 76-77), Lee (2021, 174), Chen et al. (2019, 335) and Kähkönen et al. (2021, 14) all spoke for improved digitalization and IT systems to detect disruptions early, accelerate recovery processes, and ensuring visibility through their supply chains. As Aliche et al. (2021) reported, only 23% of companies have visibility into their supply chains beyond tier 1. Therefore, the importance of increased supplier collaboration and utilizing IT in SCM were in line among the empirical study and previous research.

Lee (2021, 174) and Chen et al. (2019, 335) mentioned that digital technologies enable fast and smart real time sensing of demand and supply conditions. While the survey did not focus on the method, the most popular resilience approach was increased focus on demand forecasting. It was suggested by Kähkönen et al. (2021, 16) and van Hoek (2020, 350), as it increases the agility of a supply chain. Wagner and Bode (2008, 310) studied that when demand risk realizes, it can lead to costly supply shortages, obsolescence, and inefficient capacity utilization. Thus, the importance of demand forecasting was highlighted by both empirical study of this thesis and previous research.

Finally, it was found out that manufacturing companies were more oriented towards supply chain resilience. This can be explained by the findings of Whitney et al. (2014, 248) who

suggests that strategies mitigating disruptions are more important for companies with high product and asset specificity. For less specific physical items, that other than manufacturing companies often have, there are more available alternative sources where capabilities required to produce them are easily acquired.

As Tang (2006a, 34) argued, by improving supply chain resilience companies can reduce costs, sustain operations during and after disruption, and also benefit during normal circumstances. Chopra & Sodhi (2014, 74) mention, disruptive risks require companies to build resilience despite it might cost more. Finally, Kähkönen et al. (2021, 15) capsulize that the discussed approaches help companies to recover faster and reduce their vulnerabilities. By the popularity of the resilience approaches, companies seem to agree with the findings of these previous studies.

### 8.3 Supply base post COVID-19

As discussed in chapter 1.3, supply base is built on three key elements: source, location, and number of suppliers. Reducing outsourcing through insourcing was suggested by van Hoek & Dobrzykowski (2021) and Lee (2021), and hybrid sourcing was suggested by van Hoek & Dobrzykowski (2021). While hybrid sourcing was decently desired by manufacturing companies, increased insourcing did not gain remarkable popularity in either of the groups. These strategies gained particularly low interest among the academics, mainly because of the popularity of outsourcing. In addition, as Handfield et al. (2020, 1650) suggests, setting up new sources is time consuming, and requires a longer planning horizon than companies are willing to invest in.

Some of the most suggested supply base changes due to COVID-19 was increasing reshoring (e.g. van Hoek & Dobrzykowski 2021; Barbieri et al. 2020; Strange 2020; van Hoek 2020) and nearshoring (e.g. Aliche et al. 2021; van Hoek & Dobrzykowski 2021; van Hoek 2020; Handfield et al. 2020). As expected, nearshoring was more popular option than reshoring, presumably due to lower costs. Nearshoring was fairly popular especially with

manufacturing companies, which suggests that the previous studies were on to the phenomenon. However, reshoring was not seen attractive at all, which is in line with Näveri (2021), who reported that cost efficiency of Chinese suppliers is keeping production in Asia compared to reshoring to Finland. Also Aliche (2021) reported that companies have implemented nearshoring but not reshoring. One of the main reasons for nearshoring in the empirical study can be seen the avoidance of logistical issues, as close-by suppliers were desired to help with the matter.

When it comes to the other aspects about supplier locations, companies were not very excited about geographical diversification. It was called by Strange (2020, 463), Lin et al. (2021, 19) and van Hoek & Dobrzykowski (2021, 693), who explain that when the disruptions hit different locations during different times, it increases the probability of companies having functioning suppliers and they can switch orders between suppliers and therefore increase flexibility. Of course, there was no background study if the participants had already widespread their suppliers, but diversifying supply bases did not gain popularity in the empirical study. Also suggested by van Hoek & Dobrzykowski (2021), the origin of production might serve as a competitive advantage, and as COVID-19 could drive suppliers closer, it was studied if production location of goods affect companies' supply base decision making. However, companies did not find this attractive. Finally, a supplier location initiative that gained popularity was regional supply chains. It was suggested by Chopra & Sodhi (2014), Hayakawa & Mukunoki (2021), Chen et al. (2021), Lin et al. (2021) and Aliche et al. (2021), because it allows diversified supply bases, closeness to final customers, and reduced transportation costs. Again, the reasoning behind the answers is beyond this study, but it was one of the most popular supply base strategies in the empirical study.

Modifying supply base and the number of suppliers through dual, parallel, and multiple sourcing were among the most discussed strategies of the literature review (e.g. Tomlin 2009; Chopra & Sodhi 2014; Paul et al. 2021; Gereffi 2020; Ivanov 2020; Strange 2020; Lin et al. 2021; van Hoek 2020; van Hoek & Dobrzykowski 2021; Handfield 2020; Aliche et al. 2021). However, none of these activities gained any major interest in the answers. Only manufacturing companies had somewhat of interest towards increasing the number of

suppliers. Thus, as Cousins (1999, 146) and Trent and Monczka (1999, 931) argued, large supply bases are difficult to manage and inefficient. Ahtonen & Virolainen (2009, 268) and Berger et al. (2004, 14) noted that traditionally companies have been advised to reduce their supply bases, and these beliefs still seem to be popular.

Finally, similarly to utilizing IT and data for resilience, it was measured if digitalization driven supply chain visibility efforts affects supplier selection. While the former studied these activities within the organization and its existing suppliers, the latter focused on supplier selection. In opposite to resilience data utilization, digitalization driven supplier selection was more popular with other than manufacturing companies. Digitalization driven supplier selection was the most popular supply base strategy, implying that companies will invest in more close and reactive supplier relationships, that according to Lambert & Schwieterman (2012, 337), are traditionally encouraged when supply bases are small.

## 9. Conclusions

The main objective of this thesis was to study how Finnish companies have adjusted or how they will adjust their supply base strategies during and after COVID-19 pandemic. In addition to supply base strategies, supply chain resilience was studied as a secondary research question. This thesis provided a conceptual framework which suggested that supply base of a company is based on supplier selection which follows the initial make or buy - decision. Then, supplier selection is influenced by risk management considerations, including supply chain resilience activities. As expected in the main research question, the supply base strategies were affected by COVID-19. Finally, it is assessed how the disruptive event has shaped those strategies and activities in Finnish companies with global supply networks. The final chapter of this thesis will focus on theoretical and managerial implications to supply base strategies and supply chain resilience activities, as well as provide limitations of the study and future research suggestions. Chapter 9.1 will answer to the research questions, explain how well the research reached its objectives, and how the findings can be used in the future. Chapter 9.2 will focus on the practical suggestions gained from the study. Finally, chapter 9.3 will contemplate limitations of this study, and the further research topics that emerged from it.

### 9.1 Theoretical implications

Traditionally companies have been using strategies such as outsourcing, single sourcing, low-cost country sourcing, and avoiding large supply bases. Those strategies enable lower costs, increased efficiency, and flexibility. However, these strategies are vulnerable to supply disruptions such as COVID-19. The pandemic caused for example logistical issues, supply shortages, and increased costs and delivery times. Therefore, the main research question of this thesis was:

*How has COVID-19 affected supply base strategies in Finnish companies with global supply networks?*

It can be deduced from the empirical study that especially manufacturing companies are hoping for more diversified supply chains through increasing hybrid sourcing and nearshoring. In addition, more close-by suppliers were desired by both groups in the study. However, also highly consolidated and geographically concentrated supply chains were desired based on cost effectiveness, and regional supply chains were desired over one global supply chain. Increasing the number of suppliers through dual, parallel, and multiple sourcing were not among the popular activities. However, if companies were to select new suppliers, the digital capabilities of suppliers were desired.

These results imply that companies could be aiming to have several regional supply chains that are close to the end customers and help to reduce logistical issues. This can be achieved through developing new hybrid sources with existing suppliers and developing more nearshore sources. This allows highly consolidated and geographically concentrated supply bases in several regions, as most of the participating companies were mid- and large cap companies that operate worldwide.

What is more, the supply base activities gained notably lower interest in the empirical study compared to the supply chain resilience activities. By improving resilience, companies can mitigate disruptions with existing suppliers and within the organization, rather than making changes to supply bases that can take years. Therefore, the secondary research question of this thesis was:

*How will companies change their supply chain resilience approaches post-COVID-19?*

By far the most popular resilience activity was increased focus on demand forecasting. This is logical, since both supply and demand can fluctuate during disruptions. In addition,

increased focus on demand allows companies to utilize their resources more efficiently. Moreover, increased supplier collaboration and enhancing reactivity with IT were two other most popular resilience activities. Thus, it seems that resource utilization and reactivity has been two major issues during the pandemic. Finally, also extra inventory and reduced lead times were desired to a significant extent. Extra inventory is a great way to buffer disruptions with less effort than seeking new supply sources, and reduced lead time aims to reduce predisposed time to vulnerabilities.

To conclude the findings of this thesis, the implementation of reshoring and other supply base strategies is expensive and time consuming (van Hoek & Dobrzykowski 2021; Cousins 1999). And as Trent & Monczka (1999, 935) argued, rationalized supply base improvements are achieved through developing supplier capabilities rather than switching between suppliers. Also, Näveri (2021) pointed out, the talk of reshoring production back to Finland has increased, but cost efficiency of Chinese suppliers is keeping production in Asia. Therefore, as Kahiluoto et al. (2020, 286) put it, companies must move beyond supplier locations and size of supply bases. This can be achieved by recognizing resilience. While Lin et al. (2021, 3) argue companies with more diverse supply bases are better prepared for future disruptions, Tang (2006) notes that by improving resilience companies can reduce costs and improve customer satisfaction also under normal circumstances. Thus, with resilience companies can cope disruptions better and operate with a wider set of tools that allows better benefits-to-effort ratio.

## 9.2 Managerial implications

As COVID-19 pandemic have impacted almost all companies in the world and other disruptive events are a constant threat, this thesis provides several managerial implications that can help companies to secure their supply chains. When it comes to supply bases, instead of over-increasing them, companies should consider reconfiguring them to ensure closeness to suppliers and customers to ease logistical issues and enhance responsiveness. With supply chain resilience, companies should invest in SRM, utilization of IT, and overall reactivity to secure fluent flow of goods and information.

### 9.3 Limitations and future research suggestions

There are several limitations to the empirical study of this thesis. First, it included only Finnish companies. From a logistical point of view Finland can be considered an island, as there are very few railway connections to Europe, and road transportation requires long transitions. Finland also has very advanced technological standards, which might not be the case in other countries. Secondly, the sample size contained only mid- and large cap companies. Bigger companies have more resources to invest in new initiatives, while small and medium sized companies (SME's) might not have the same resources. Thirdly, the study was conducted as a quantitative survey, which do not provide reasoning behind answers. Fourth, the sample size of the survey was more directive than rigorous when it comes to the accuracy of the results. And finally, the COVID-19 pandemic is still ongoing, and companies had to measure their activities in retrospective about two years into the pandemic. These two factors could explain the differences compared to studies conducted at the beginning of the pandemic, and also to studies that will be conducted once the pandemic is over.

Future research could study the reasoning behind the popular activities with qualitative research methods. Also, the viewpoint of SME's would be interesting on the matters, and if there are any differences compared to the approach of larger companies. And while there are some large-scale studies on COVID-19 and supply chains, most current studies have somewhat small sample sizes, at least regarding supply base studies. Finally, many supply chain resilience activities were more popular among manufacturing companies. Thus, resilience in manufacturing environment and in comparison to others could be studied further.

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## Appendix 1: Survey

### Supply base and resilience efforts post COVID-19

#### Background information

##### 1. Please state your company's industry \*

- Chemicals
- Consumer goods
- Consumer services
- Electronics
- Energy
- Finance
- Food and beverages
- Forestry
- Healthcare
- Machinery
- Metal products
- Mining
- Shipbuilding
- Technology
- Other

**2. Company size \***

- 1-10 employees
- 11-50 employees
- 51-250 employees
- 251- employees

**3. Company revenue \***

- Less than 2 million €
- 2-10 million €
- 11-50 million €
- Over 50 million €

**4. Does your company have a global supply network? \***

- Yes
- No

**Situation before COVID-19**

How well the next statements describe your company's situation before COVID-19? (1 = not at all, 5 = to a great extent)

**5. We were well prepared for supply disruptions \***

- |   | 1                     | 2                     | 3                     | 4                     | 5                     |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| * | <input type="radio"/> |

**6. We were too dependent on offshore/distant suppliers \***

---

	1	2	3	4	5
*	<input type="radio"/>				

**7. We were too dependent on single sourcing \***

	1	2	3	4	5
*	<input type="radio"/>				

**8. Complex relationships with key suppliers set our supply chain to vulnerabilities \***

	1	2	3	4	5
*	<input type="radio"/>				

**9. COVID-19 pandemic related issues have affected our supply chain \***

	1	2	3	4	5
*	<input type="radio"/>				

**10. Strategies mitigating supply disruptions are costly, and before COVID-19 we did not want to implement them because disruptive events are rare \***

	1	2	3	4	5
*	<input type="radio"/>				

### **Supply chain resilience after COVID-19**

How much of the following measures your company has implemented because of COVID-19? (1 = not at all, 5 = to a great extent)

**11. We carry extra inventory to buffer disruption \***

---

	1	2	3	4	5
*	<input type="radio"/>				

**12. We have increased supplier collaboration to enhance supplier responsiveness \***

	1	2	3	4	5
*	<input type="radio"/>				

**13. We shift production between locations to avoid disruption \***

	1	2	3	4	5
*	<input type="radio"/>				

**14. We developed new back-up suppliers \***

	1	2	3	4	5
*	<input type="radio"/>				

**15. We utilize IT/data for screening disruptions and enhancing reactivity \***

---

	1	2	3	4	5
*	<input type="radio"/>				

**16. We use alternative logistic modes/routes improve our resilience \***

---

	1	2	3	4	5
*	<input type="radio"/>				

**17. We aim to reduce lead times \***





(1 = not at all, 5 = to a great extent)

**28. We aim to reduce dependency on highly concentrated supply base by increasing the number of suppliers \***

	1	2	3	4	5
*	<input type="radio"/>				

**29. We aim to increase dual sourcing \***

	1	2	3	4	5
*	<input type="radio"/>				

**30. We aim to increase parallel sourcing \***

	1	2	3	4	5
*	<input type="radio"/>				

**31. We aim to increase multiple sourcing \***

	1	2	3	4	5
*	<input type="radio"/>				

**32. Highly consolidated and geographically concentrated supply base is desired based on cost effectiveness \***

	1	2	3	4	5
*	<input type="radio"/>				

**33. More diversified supply chain reduces our risks \***

	1	2	3	4	5
*	<input type="radio"/>				

**34. We differentiate our supplier strategies between product categories \***

	1	2	3	4	5
*	<input type="radio"/>				

**35. Digitalization driven supply chain visibility efforts affects our supplier selection \***

	1	2	3	4	5
*	<input type="radio"/>				