EFFECTS OF COVID-19 TO SUPPLY CHAIN RISK MANAGEMENT IN FINNISH COMPANIES

ABSTRACT

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Effects of COVID-19 to Supply Chain Risk Management in Finnish Companies

The COVID-19 pandemic has affected Finnish companies extensively. Supply chain disruptions have arisen as Finnish companies have global supply chains and raw-materials are purchased from suppliers abroad. The companies' supply chains and global purchasing have experienced disruptions. These disruptions have been tried to be prevented and mitigated by supply chain risk management. Increased delivery times, shortage of goods and increased prices have forced companies to come up with solutions to ease the situation. The companies' strategies for preventing and mitigating disruptions have been various and have also changed due to COVID-19 pandemic.

The purpose of this study is to find out how COVID-19 has affected the supply chain risk management in Finnish companies. Supply chain risk management is examined from the point of view of the purchasing side of Finnish companies. A literature review was conducted in the research, which supports the empirical part. The research's empirical data was collected as a semi-structured interview study. The data consists of four interviews and the research method used is qualitative.

The results of the study indicates that the supply chain risk management of Finnish companies has been widely affected by COVID-19. Smaller companies that have not had advanced risk management strategies have experienced the effects more widely than larger companies. Individual observations of the effects are the more emphasized near-shoring, focus of price increases as part of risk management and general uncertainty about the future. In addition, companies have noticed the importance of supply chain risk management and are willing to focus more in it in the future. The pandemic has also had positive effects, as supplier relations are perceived to have improved due to COVID-19. The COVID-19 pandemic is also seen to have accelerated the development of technology, which is believed to be utilized more in supply chain risk management in the future.

TIIVISTELMÄ

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COVID-19 vaikutus toimitusketjun riskienhallintaan suomalaisissa yrityksissä

COVID-19 pandemia on vaikuttanut suomalaisiin yrityksiin laajasti. Toimitusketjuhäiriöitä on syntynyt, sillä suomalaisilla yrityksillä on globaaleja toimitusketjuja, jossa mm. raaka-aineita hankitaan ulkomaisilta toimittajalta. Yritysten toimitusketjut sekä globaali hankinta ovat kokeneet häiriöitä, joita on pyritty estämään ja lieventämään toimitusketjun riskienhallinnalla. Toimitusaikojen kasvaminen, tavarapula ja hintojen nousu ovat pakottaneet yritykset tekemään ratkaisuja tilanteen helpottamiseksi. Yritysten strategiat häiriöiden estämiseksi sekä lieventämiseksi ovat moninaisia ja myös muuttuneet COVID-19 pandemian myötä.

Tämän tutkimuksen tarkoituksena on selvittää miten COVID-19 on vaikuttanut suomalaisten yritysten toimitusketjujen riskienhallintaan. Toimitusketjun riskienhallintaa tarkastellaan suomalaisten yritysten hankintapuolen näkökulman kautta. Tutkimuksessa tehtiin kirjallisuuskatsaus, joka tukee empiiristä osaa. Tutkimuksen empirian aineisto kerättiin puolistrukturoituna haastattelututkimuksena. Aineisto koostuu neljästä haastattelusta ja käytetty tutkimusmenetelmä on kvalitatiivinen.

Tutkimuksen tulokset osoittavat, että COVID-19 on vaikuttanut suomalaisten yritysten riskienhallintaan laajalti. Pienemmät yritykset, joilla ei ole ollut kehittyneitä riskienhallintastrategioita, ovat kokeneet vaikutukset laajemmin kuin suuremmat yritykset. Yksittäiset havainnot vaikutuksista ovat near-shoren lisääntyminen, hintojen nousun sisäistäminen osana riskienhallintaa ja yleinen epävarmuus tulevaisuudesta. Yritykset ovat lisäksi huomanneet riskienhallinnan merkityksen ja tahtotila on panostaa siihen enemmän jatkossa. Pandemialla on ollut myös positiivisia vaikutuksia, sillä toimittajasuhteiden koetaan parantuneen COVID-19 myötä. COVID-19 pandemian nähdään vauhdittaneen myös teknologian kehitystä, jota uskotaan hyödynnettävän tulevaisuudessa yhä laajemmin toimitusketjun riskienhallinnassa.

ACKNOWLEDGEMENTS

ABBREVIATIONS

SC	Supply Chain
SCM	Supply Chain Management
SCRM	Supply Chain Risk Management
SCRes	Supply Chain Resilience

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1. INTRODUCTION

With supply chain risk management (SCRM) companies try to mitigate the potential risks and lower the vulnerability in supply chains (SC). However, in 2019 unknown threat called COVID-19 destabilized and eventually reshaped companies SC and SCRM. This virus from China spread across the world and caused disruptions also in Finnish companies with global supply networks. Due to restrictions in every continent, the supply chains were reshaped globally and disruptions in every part of supply chains realized. Companies needed to adapt the situation with their SCRM to be resilient and agile against this unknown threat. According to Wagner & Bode (2006) modern global supply chains are more vulnerable for disruptions than before. Disruption sources varies as they can be internal or external, ranging from supplier risks to different disasters e.g. terrorism, natural hazards or geopolitical crises. Pandemic as a natural hazard caused imbalance between supply and demand as lockdowns and restrictions were in place globally (Nikolopoulos, Punia, Schäfers, Tsinopoulos & Vasilakis, 2020). COVID-19 has proved that supply chains are extremely vulnerable as global supply chains are complex network demanding that every member of the company's supply chains functions effortlessly. Though COVID-19 is still rather new phenomenon, it is studied a lot. However the effects to companies' SCRM is quite new topic as the consequences haven't been able to see until now when the restrictions of pandemic is slowly fading and companies are starting gradually recover from pandemic.

1.1 Background of the topic and research questions

Over two years ago the world faced an unknown threat – pandemic COVID-19 that spread around the world fast. The pandemic impacted global supply chain's considerably (Paul et al., 2021). Pandemic caused several disruptions to world's economics and supply chain's resiliency all over the world. Consumers behavior changed when the threat of pandemic became real as life changed because of restrictions. For example demand of services and products started to change repeatedly such as high need of hygiene products and low demand of clothing, also online shopping grew largely (Paul & Chowdhury, 2021). For companies

this meant adaptation to a totally new situation and at same time battling with global supply disruptions – some industries suffering more than others.

However, COVID-19 isn't only threat that the world has faced in the past years. These threats such as pandemics and epidemics has caused supply chain disruptions which have negative consequences to companies operations such as return on profit, brand image, employment of the firms and supply chain performance (Paul & Chowdhury, 2021). World Health Organization (WHO) has reported almost 1500 epidemics between years 2011 and 2018 so COVID-19 isn't and will not be the first wave. Although it has been different because of its spreading speed over a larger area in the world. Global warming is one reason why pandemics spread globally and eventually disturb economics widely. (Hudecheck et al., 2020.)

As COVID-19 has been unexpected and completely new threat because of its spreading globally it has an effect to companies SCRM. Pandemic has revealed truly the vulnerability of supply chains. (Bank of Finland Bulletin, 2021.) Suppliers struggling with high or low demands has an effect to companies who serve end customers. COVID-19 may have caused a permanent impact for companies supply chain risk management. These impacts are worldwide and concerns almost every company regardless of the industry all over the world. Therefore the research focuses on impact of COVID-19 to companies supply chain risk management in Finland. In addition, the research focuses on what kind of supply chain disruptions have been detected in companies' purchasing and how companies have reduced these disruptions. This underlines if and how COVID-19 has effected to SCRM in Finnish companies and therefore might help companies to mitigate risks in the future.

The topic was chosen for its topicality as COVID-19 has concerned everyone's lives as someway. It is important to know what kind of risk management practices companies had before and during pandemic as well as what kind of effect there are on their supply chain risk management afterwards.

1.2 Research questions and conceptual framework

Title of the thesis is

> *Effects of COVID-19 to supply chain risk management*
> *in Finnish companies*

Main research question is

> *How COVID-19 has affected to supply chain risk management in Finnish companies?*

Sub-research questions are

> *What kind of supply chain disruptions have been detected in companies because of*
> *COVID-19?*

> *How companies have reduced disruptions caused by COVID-19?*

The main goal of this study is to find out how COVID-19 has effected to companies supply risk management in Finnish companies. This is considered from perspective of supply chain management and supply chain risk management as well as focusing on purchasing aspect of SCRM. Figure 1. illustrates below the reference of the study, to provide a practical structure and to support the research questions.
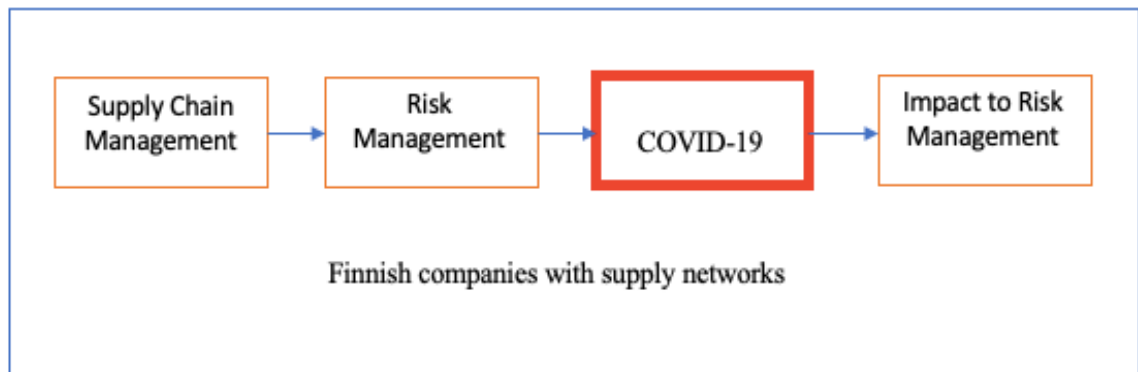
Figure 1. Conceptual framework

The theory of this thesis is based on supply chain management and supply chain risk management. These theories are deepened with features of supply chain risks and the purpose of purchasing.

1.3   Definitions of key concepts

Supply chain is composition of various organizations which are part of upstream and downstream flow in network (Mentzer et al., 2001).

Supply chain management is a strategic function of a company that is proactive and cross-functional for obtaining products and services while managing suppliers. It requires coordination of production, inventory, location and transportation to achieve the best efficiency for the market being served and delivering the end-product. (Trent, 2007.)

Supply chain risk management stands for organization's ability to understand and also manage its environmental, economic and social risks in supply chain. For a company it is vital to recognize and evaluate their risks to make right choices and actions to minimize and avoid those risks. (Carter & Rogers, 2008.)

Purchasing is defined as a sourcing of goods and services from external suppliers while it has a critical role in company's competitive advantage. It is "the management of the company's external resources in such a way that the supply of all goods, services, capabilities and knowledge which are necessary for running, maintaining and managing the company's primary and support activities is secured at the most favorable conditions." (Van Weele, 2018.)

Risk can be defined as possibility of undesired consequence such as damage, danger or loss (Harland et al., 2003).

Resilience means one kind of capability in supply chain that is defined by Hohenstein, Feisel, Hartmann & Giunipero (2015) as "ability to be prepared for unexpected risk events, responding and recovering quickly to potential disruptions to return to its original situation or grow by moving to a new, more desirable state in order to increase customer service, market share and financial performance."

COVID-19 is a disease that turned into pandemic caused by a new strain of coronavirus (World Health Organization, 2020). Virus started to spread around the world in the end of 2019 causing major disruptions everywhere. WHO has reported over 6 million deaths caused by COVID-19.

1.4   Research methodology and data collection

Qualitative research method has been used when answering the research questions of this study. A qualitative research is based on methodological traditions that study social problem (Creswell, 1998). Opposite than quantitative method that focuses on using examination of amounts, frequency and intensity, qualitative method approaches concepts in terms of their meaning and rendition in specific context of inquiry (Ketokivi & Choi, 2014). Also, qualitative method is often chosen as it generates information from certain phenomena. It usually achieves more in depth-results for research. (Betancourt et al. 2016, 192.) Qualitative

research often answers to questions "how" and "why", which especially are suitable for this specific research.

This research's empirical part is implemented through interviews. Semi-structured interview was chosen as the interview method. According to Babbie (2011) semi-structured interviews have the possibility of changing the set of questions and allowing to find new fields of the research topic. On the other hand semi-structured interviews concern is about reliability due to lack of standardization (Saunders, 2015). However Eriksson & Kovalainen (2008) stated that the biggest advantages of this kind of interviews are that interviews are quite conversational and the materials are usually comprehensive. These proposed circumstances supports the semi-structured interview as a method for this study.

Interviews seek answers and opinions from local entrepreneurs on effects of COVID- 19. It is beneficial for data collection that interviews are flexible. During the interviews there are opportunity for interviewer to ask additional questions from interviewees and clarify the answers of the interviewees when needed (Tuomi & Sarajärvi, 2002, 85).

1.5   Limitations of research

This study focuses on the effects of COVID-19 to supply chain risk management of purchasing process in Finnish companies as global pandemic has had a major impact to companies supply chain regardless of the industry. Although companies maintain their risk management various ways, COVID-19 has been a new and unknown threat for companies regardless of the industry –some other sectors suffering more than others. By studying what kind of risk management companies had before pandemic, what kind of disruptions they have experienced and how companies had mitigate the COVID-19 effects, it can be found what effects COVID-19 has brought to supply chain risk management.

COVID-19 is still rather new and topical, though it has been studied already. Nevertheless as the topic is quite new so companies might not yet recognize all consequences to their risk management and purchasing process. This study focuses on Finnish companies with global supply network regardless of the industry and size, which effect to reliability as the sample is limited by geography. Also as companies' industries and sizes varies, answer may be multidimensional because companies' purchase types are not limited to specific goods

and/or raw-material. The conclusion of the study might be a bit different if this study would be held years from now and for a different sample of companies.

1.6 Structure of the thesis

This master's thesis is divided altogether into six bigger entirety which are divided to theoretical and empirical parts. First three chapters are handling the theory of thesis and chapters four, five and six empirical aspects.

Introduction	• Research background, research questions • Objectives, limitations
Main literature review	• Background of supply chain risk management
Literature review	• COVID-19
Methodology	• Data collection and analysis • Reliability and validity
Empirical analysis	• Effects of COVID-19 in supply chain risk management in case companies
Discussion and conclusions	• Findings of the study • Answering research question • Suggestions for future research

Figure 2. Structure of the master's thesis

As seen in Figure 2. above, the thesis starts with introduction where the background of the study and research questions are presented. Also key concepts are defined and objectives and limitations are determined. The second chapter introduces the conceptual framework on the thesis which means the main concepts supply chain management and risk management by background of supply chain risk management perspective. After that the pandemic COVID-19 is defined based on the previous literature. The fourth chapter presents methodology used in this study as well as the data collection method and analysis. Also reliability and validity of the study is covered. The fifth chapter analyses the empirical results of COVID-19's effects in supply chain risk management in case companies. The last chapter focus on discussion and conclusion which sums up findings of the study and answers research question. Also suggestion for future research are concluded in the sixth chapter.

2. BACKGROUND OF SUPPLY CHAIN RISK MANAGEMENT

Every company needs supply chain (SC) and is part of it somehow to provide the goods they need to keep the business running and be successful. As every company is part of it, SC's goal is to provide the goods for end user (Hugos, 2018). Wider definition for SC includes all the activities such as raw-material acquisition, warehousing and final delivery that are needed when the end-product is delivered to end-user (Lummus and Vokurka, 1999). Also Christopher & Beck (2014) defines supply chain through its activities and delivering value as according to them definition for supply chain is: "the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer". Therefore as supply chain is combination of different organization and companies, it is vital that the whole chain functions effortlessly.

However, Trent (2007) states that previously SC was seen only as additional function that didn't benefit the company. Nowadays SC has one of the most important role in business practices as without it the end-customer wouldn't receive the goods at the right time and right shape. As Mentzer et al. (2001) states that the supply chain is group of over three individuals or organizations involved to upstream and downstream flow in different operations. All in all SC definition come to same conclusion: SC is network of different organizations and stakeholders working together to provide smooth flow for information and materials.

One big factor for SC's efficiency is functional purchasing. Van Weele's (2018) definition for purchasing is "the management of the company's external resources in such a way that the supply of all goods, services, capabilities and knowledge which are necessary for running, maintaining and managing the company's primary and support activities is secured at the most favorable conditions." Therefore purchasing is vital part in every business as goods such as components and raw materials are purchased from external suppliers and

therefore it plays a huge role in part of company's supply chain. In this thesis, purchasing is examined through supply chain risk management as part of the case companies' process.

2.1 Supply chain management

Supply chain management (SCM) is function for managing SC. As every company is part of SC therefore also SCM is needed to sustain functional flow in supply chains. Global purchasing in particular has highlighted the importance of SCM. History of SCM is related to inventory management as literature of SCM concerns the logistics literature after all (Ellram & Cooper, 1993). As SC is described by its activities, SCM coordinates it among the participants of SC to achieve the efficiency and reactivity for the market (Hugos, 2018). Kraljic (1983) made a significant statement in his article, where supply management was stated as strategic function for a company as SCM helps stabilize supplier relationships and product development in competitive market. Mentzer et al., (2001) share the definition of SCM as a strategic function and adds more comprehensive definition for it as it is stated as: "the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole"

According to Mentzer et al. (2001), goal of SCM is creating customer satisfaction and value. In order to achieve this, SCM philosophy contains all activities in supply chain and are not seen only as a logistics function. To understand the philosophy better in practice, SCM is based on following characteristics:

1. Examining the supply chain in a big picture when managing the flow of goods inventory from the supplier to the end customer
2. Strategic cooperation with internal and external stakeholders to accomplish shared entity
3. Focusing on customers by creating customer value with unique sources to achieve customer satisfaction

Mentzer et al. (2001) adds, that SCM is full of activities. The goal of these activities is to achieve a functioning SCM philosophy. Many previous studies have focused on activities, which are gathered and presented in more detail in the Table 1. below.

Table 1. SCM activities (adapted from Mentzer et al., 2001)

Authors	Supply Chain Management activities
Bowersox and Closs (1996)	Integrated Behavior
Cooper et al. 1997; Cooper, Lambert, and Pagh 1997; Ellram and Cooper 1990; Novack, Langley, and Rinehart 1995; Tyndall et al. 1998	Mutually Sharing Information
Cooper and Ellram (1993)	Mutually Sharing Risks and Rewards
Ellram and Cooper (1990); Tyndall et al. (1998)	Cooperation
Lassar and Zinn (1995)	The Same Goal and the Same Focus on Serving Customers
Cooper et al. 1997; Cooper, Lambert, and Pagh 1997; Ellram and Cooper 1990; Novack, Langley, and Rinehart 1995; Tyndall et al. 1998	Integration of Processes
Cooper et al. 1997; Ellram and Cooper 1990; Tyndall et al. 1998	Partners to Build and Maintain Long-Term Relationships

In order for SCM to be implemented successfully, the company must implement the activities in its operations. Various authors have suggested different activities of SCM. Bowersox & Closs (1996) suggests that 'Integrated behavior' is one activity in SCM which means company's external integration to suppliers and other stakeholders as well as partners in supply chain. 'Mutually sharing information' is activity that many authorities has stated

for SCM activity. Mutually sharing information is required especially when implementing process monitoring. In practice this means that data is available for every member of company's supply chain. This contains data such as different forecasts, inventory levels and different strategies. Shared data improves the relationships between partners and competitive advantage. (Cooper et al. 1997; Cooper, Lambert, and Pagh 1997; Ellram and Cooper 1990; Novack, Langley, and Rinehart 1995; Tyndall et al. 1998). Cooper & Ellram (1993) suggest 'mutually sharing risks and rewards' as one activity. In order for cooperation in the supply chain to develop, it is important to share risks and rewards in the long term. This achieves competitive advantage for company as positive and negative aspects are shared with partners. 'Cooperation' is activity that is needed for agile and effective SCM. According to Cooper et al., (1997) cooperation needs to be cross-functional in all levels of supply chain and management. 'The same goal and the same focus on serving customers' is activity for its part that focuses on collaboration with all supply chain members. According to Lassar & Zinn (1995) the aspiration is for cooperation with a congruent culture, which in part lowers the company's costs. 'Integration of processes' are activity that focuses on integrating different processes such as purchasing, manufacturing and distribution (Cooper et al 1997). Lastly activity 'partners to build and maintain long-term relationships' is required for effective supply chain as according to Cooper et al. (1997) it means that company has reasonable amount of partners to maintain proper cooperation and long-term relationships with long time frame.

Besides activities Menzer et al. (2011) adds that SCM is seen also as set of management processes. These processes goal is to meet the customers' requirements as the customer is at the center of the process. Lambert, Stock, and Ellram (1998) argues that key processes include e.g. customer service management, demand management, order management and procurement. Menzer et al. (2021) suggests that supply chain is seen as a pipeline with supply chain flow (products, services) inside of it. Functions such as forecasting, logistics and purchasing manage these flows from suppliers to the customers. This entity is called supply chain management. According to these findings, SCM has a crucial role in every business despite the industry and cannot be underestimated. The scope and complexity of SCM depends on the company and its size and industry.

2.2 Supply chain risks

To fully understand supply chain risk management, the concept of risk needs to be clarified. The definition of risk is crucial in every field of business and it can be understood in many ways regarding of the operational level. In this thesis risk is researched from supply chain and purchasing point of view. Risk as a term has a multiple definitions in literature but Manuj & Mentzer (2008) defined two components of risks by combining literature and interviewing supply chain managers:

1. Prospective losses if risk is realized; significance of consequences
2. Probability of losses; leads to realization of risk

Simplified definition for risk is that it is a chance for undesired negative and harmful consequences (Harland et al., 2003). To broaden Manuj's & Mentzer's definition of risk components, the overall risk is the overall sum of all individual potential risks. It is also stated that risk can be imperfect knowledge, as risk is not always known and well-defined (Mitchell, 1995).

There are various definitions for supply chain risks but one comprehensive is from Jüttner et al. (2003) stating that it means any risks related in the immaterial or material supply chain flows, and the imbalance between supply and demand. Other wider definition discusses that supply chain risk (SC risk) means the potential failure from individual supplier as inbound supply, that causes harm for the purchasing company as they are not able to meet the customer demand (Zsidisin, 2003). On the other hand Trent & Monczka (1999) states that supply chain risk could mean supplier failure such as failure of quality requirements of the buying company. Ho et al. (2015) carried out a literature review of over 200 scientific articles and based on that defined SC risk as "the likelihood and impact of unexpected macro and/or micro level events or conditions that adversely influence any part of a SC leading to operational, tactical, or strategic level failures or irregularities." As a conclusion all researches underlines that SC risk stands for the unexpected event impacting to any supply chain's operations as a negative event.

Nowadays when world is more globalized than ever also supply chains are more complex than before. That means more vulnerability and sensitivity in modern supply chains when world is more unstable in these days. (Wagner & Bode, 2008.) As Harland, Brenchley & Walker (2003) stated, previously supply chains were easier to manage as companies manufactured, sourced and sold locally and therefore less risks occurred. It can be then concluded that if nowadays risks occurred previously, they wouldn't cause that much negative consequences as in today's world's supply chain. All in all supply chain risks are real and requires agility and flexibility from companies to manage these risks in this modern society.

Supply chain risks can be divided into different categories by the type of the risk. It is noticed that identifying the possible sources of supply chain risks such as categorizing them helps in supply chain risk management (Chopra & Sodhi, 2004). Several authors have categorized supply chain risks in various ways. According to Ho et al. (2015) as illustrated in Figure 3., the supply chain risks can roughly be separated into two categories: micro-risks and macro-risks. Micro-risks are risks that occur internally referring for example to operations in a company or relationships with stakeholders in a supply chains. Also, these kind of micro-risks are relatively common events in companies and the impact isn't that negative as in macro-risks. Macro-risks are relatively rare events that are divided to natural risks such as weather-related risks and man-made risks such as terrorism and war. Therefore COVID-19 can be categorized as a macro-risk that is natural risk as it is not man-made and not common risk although the consequences are highly negative.
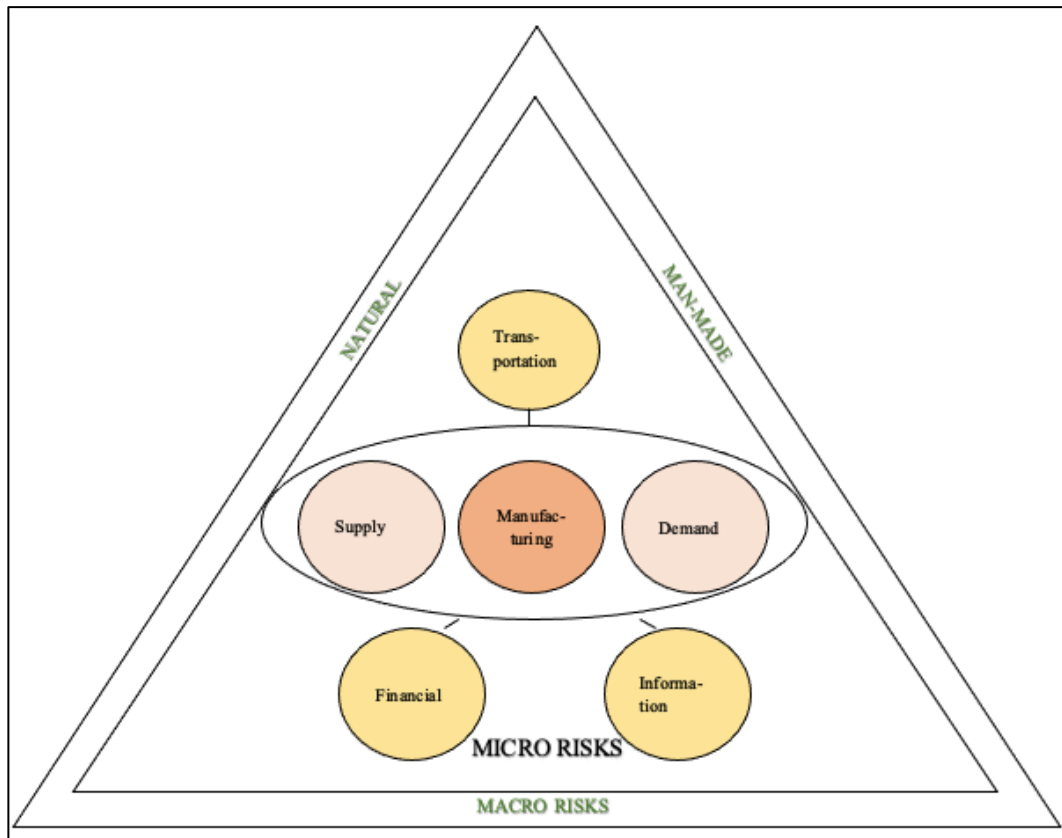
Figure 3. Supply chain risks (Ho, et al. 2015)

As Figure 3. illustrates micro-risks are more likely for a company in a supply chains' function. Ho et al. (2015) clarifies that micro-risks are categorized further to four subcategories: supply risk, manufacturing risk, demand risk and infrastructural risk (transportation, financial and information risk). Therefore transportation, information and financial systems are crucial to ensure an agile supply chain flow as any disruptions in these systems can lead to extensive problems. These kind of risks are earlier mentioned infrastructural risks that refers to micro-risks in a company. Next the six micro-risks, demand-, manufacturing-, supply-, information-, financial- and transportation risks are explained further.

Demand risk is defined by Wagner & Bode (2008, 310) as a risk that occurs usually when supply chain is badly coordinated such as forecasted demand and actual demand doesn't meeting. Johnson (2001, 110) states that demand risks are also associated to changes in

demand such as variation of trends, seasonality and product lifecycles. Demand risk causes supply distress and inefficient capacity usage that leads to expensive outcome in a company. Manufacturing risks are risks that impact company's ability to produce goods and services as well as meeting the right quality at the right time at the right price (Wu et al., 2006). Manufacturing risks leads to poor outcome when company suffers from manufacturing problems. Supply risks can be defined in various way as stated earlier in this thesis. One comprehensive definition is from Zsidisin (2003b, 222) stating that supply risk is an event where individual supplier fails and causes harm for the buying company as they cannot serve its customers as expected. Information risks – so called IT risks are genuine risks nowadays when modern SCM rely on digital information when for example place and time of delivery has to be ensured effectively (Fischer-Preßler, Eismann, Pietrowski, Fischbach & Schoder 2020, 233). Companies needs to adapt with technology to keep the competitiveness and agility as data is necessary tools nowadays. This means that there are external threats such us falsification or cyber risks (Urciuoli & Hintsa 2017). Financial risks covers different financial aspects such as financial strength of customers, price fluctuation and changes in interest rate level (Ho et al., 2015). Therefore it can be stated that financial risks covers wide variety of risks and is composed by external risks that company cannot influence and internal risks that are related to company's operations. Transportation risks have paid less attention than others (Ho et al., 2015). However, transportation risks is very disruptive according to its extensive nature as the other supply chain functions suffer from it as well. Transportation risk is defined by Wagner & Neshat (2010) as supply chain complexity problem when transportation risk occurs.

Risks mentioned above are the six most noticed risks in micro-risk category that presents company's so-called internal risk that are recurrent events in a company. In addition, the two macro-risks, natural risks and man-made risks occur rarely but are known as catastrophic events for a company (Ho et al., 2015). Other categorization for supply chains risks is from Wagner & Bode (2008) suggesting five different categories for supply chain risks. These classes are 1. demand side 2. supply side 3. regulatory, legal and bureaucratic, 4. infrastructure and 5. catastrophic. Mentioned risk classes are illustrated in Figure 4. Demand side risks refers to downstream supply chain operations where risks occur when customer demand and company's performance do not meet. This is situation is caused for example

from distribution problems in company. Supply side risks are associated for one's part to upstream supply chain such as purchasing and supplier relationships. These are risks such as supplier business risks causing disruptions like component shortages for company. Regulatory, legal and bureaucratic consists legislative and supply chain related laws that affects to companies supply chains. Laws can cause barriers for supply chain performance as it is external risk for a company. Infrastructure risks includes company's infrastructure such as IT and machines operating supply chains. These risks happens when these infrastructures experience a disturbance such as breakdowns. Supply chains are largely based on different information sharing with various company's internal infrastructure which means that disruptions are threatening for functional supply chain. Catastrophic risks are events such as natural hazards and pandemics and epidemics. Supply chain systems and operations are vulnerable for these kind of events globally (Wagner & Bode, 2008). Consequently, COVID-19 can be referred to catastrophic risk due to it features.
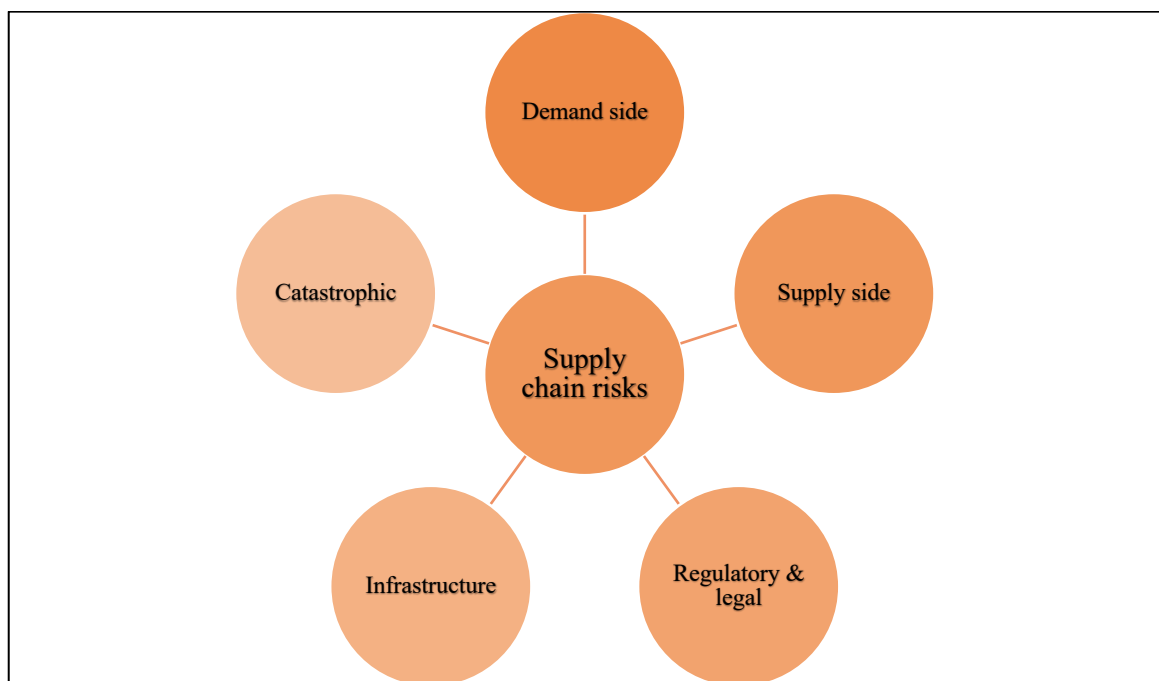

Figure 4. Supply chain risk categorization (according to Wagner & Bode, 2008)

As stated, COVID-19 can be categorized as macro level risk that is natural risk due to previously presented risk types. This kind of risk impacts every part of company's supply chain. Though it is rare as a risk type the impact of it is enormous.

2.3 Supply chain risk management

Supply chain and purchasing are vulnerable functions as they are sensitive to various risks. History has pointed out that companies supply chains are easily disrupted by different unfavorable events. Few to mention, the earthquake that caused after all nuclear crisis in Japan in 2011 caused extensive financial loss for Toyota and catastrophic flooding in Thailand in same year 2011 caused massive disruptions at different industries such as computer and automotive manufacturers (Ho et al, 2015). As it has been proven in history – many events are accidents that are not under human's control. COVID-19 is the recent example of it and how supply chains are extremely fragile of any disruptions. In order to control these events, supply chain risk management (SCRM) is area that needs powerful focus that potential risks can be controlled and decreased.

Ho et al. (2015) defines comprehensively risk as "the likelihood and impact of unexpected macro and/or micro level events or conditions that adversely influence any part of a SC leading to operational, tactical, or strategic level failures or irregularities." These risks are managed with supply chain risk management (SCRM) which aim is to evaluate possible risks and utilize strategies to mitigate supply chain vulnerability (Jüttner et al., 2003). SCRM has been studied widely in literature review but other practical definition is from Carter & Rogers (2008) stating that SCRM is a company's skill to fully understand and manage its environmental, social and economic risks in supply chain. Based on many studies of topic Ho et al. (2015) defines SCRM extensively 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".

SCRM can be seen as a process, where company collaborates with its associates as goal to lower supply chain's vulnerability and at the same time increasing the level of smooth flow (Jüttner, 2005; Tang, 2006). Different SCRM methods have been presented widely by various authors in literature. Both Ho et al. (2015) and Hallikas, Karvonen, Pulkkinen, Virolainen & Tuominen (2004, 52) present four steps of SCRM which includes the main elements as other SCRM prosesses: 1. risk identification, 2. risk assessment, 3. risk mitigation, and 4. risk monitoring. These steps are illustrated below in Figure 5.
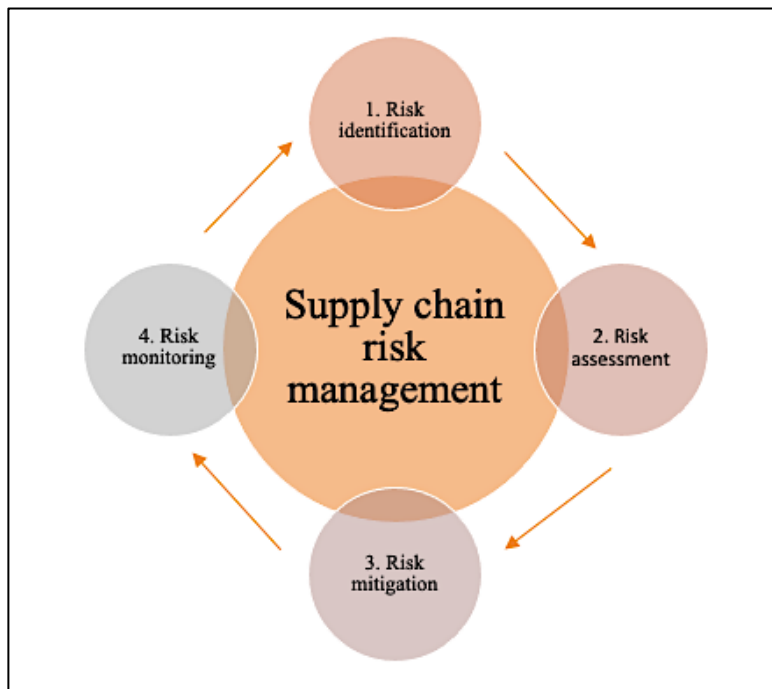
Figure 5. Four steps of SCRM (adapted from Ho et al., 2015 & Hallikas et al., 2004)

According to Ho et al. (2015) the first step of SCRM process is risk identification. The first step requires identification of risk types and factors. This determines the possible risks and their appearance in company's supply chain. Second step risk assessment pursues to find the likelihood the risk to occur as well as weight of the consequences for company. Risk assessment can be divided to macro- and micro risk assessment referring to categories presented before in Figure 3. Third step risk mitigation seeks to find strategies to minimize the possible risks. This step as well is categorized by risk types: macro-, demand-, manufacturing-, supply-, transportation-, financial-, information- and general risks. Final

step in SCRM process, risk monitoring, helps to keep in track as a pre-warning system whether unusual data occurs in company's processes. More simplified process by Wieland & Wallenburg (2012) is to divide SCRM into two strategies: robustness and agility. Robustness strategy is proactive, where the supply chain is adjusted in advance so that disturbances do not arise in the future. Robust supply chain's goal is to rather resist the change rather than responding to it. As a opposite strategy, agility focuses on the ability to respond quickly to changes in the supply chain. The supply chain does not change due to possible disruptions in advance, but rather adapts to disruptions with its flexibility and agility. Both strategies are usually used simultaneously to reduce the effects of risks.

According to Zsidisin & Ellram (2003, 15) the goal of SCRM are more of eliminating the potential risks than only minimizing them. Manuj & Mentzer (2008a) adds that SCRM's goal is to achieve cost savings and due that cost-effectiveness. Other statement for a SCRM's objective is to avoid "ripple-effects", which means that initial disruption spreads disturbing wider system (Norrman and Jansson, 2004). These findings highlights that goal of SCRM is mainly reducing prospective risks and with that achieving also financial benefits. This happens both by proactive actions and reducing actions as mitigating potential risks beforehand and by reacting when the risk is realized.

2.4 Supply chain resilience

These days as global supply chains are more complex and companies supply chain are more vulnerable for different disruptions it is necessary to cope with different interrupts and unpredictable events. Events such as terrorism, natural disasters and pandemics like COVID-19 are nowadays examples for possible but rare events. Forecasting those issues mitigates negatively effective unexpected situations and in a best possible situation company's supply chain can continue operating efficiently. This kind of unwavering supply chain can be defined as resilient supply chain. Supply chain resilience (SCRes) is one of the concept from wider perspective of supply chain risk functions. Christopher & Beck (2014) defines resilience as "the ability of a system to return its original state or move to a new, more desirable state after being disturbed". Brusset & Teller (2017) adds that supply chain resilience is more important than ever for companies as there are more possible disruptions

that underlines the importance of quick recovery for company's survival. According to Hobbs (2021), during COVID-19 supply chain functions has demanded to transform to the current situation flexible and effectively. Therefore the importance of resilient supply chain has emphasized. According to Yossi & James (2005) resiliency is strategic choice for a company and requires centralization to company's operations. Resilient supply chain bounces back easily from disruptions as supply chain is not that vulnerable. Achieving resiliency requires 1. increased flexibility or 2. created redundancy in operations.

Latest the COVID-19 has revealed the risks and vulnerability in companies supply chains. To avoid negative supply chain performance companies need to manage their supply chains to achieve the demanded resilience. Some operations have an negative effect for resilience. Blackhurts, Dunn & Craighead (2011) represents factors that reduces supply chain resiliency:

1. Activity flows such as transportation
2. Unit flows such as product manufacturing
3. Source of flow such as instability of supplier

Presented factors above reduces company's supply chain. According to Blackhurts et al., (2011) these factors disrupts normal, smooth flows in supply chains. Activity flows such as transportation, unit flows such as product manufacturing and source of flow such as instability of supplier are factors that can be stated as pitfalls for company's supply chain resiliency. Executions for maintaining the resilience is necessary to do rapidly as the longer it takes, the negative effects expands and impacts widely for company's perform. On the other hand there are actions that enhances company's resilience. According to Blackhurts et al. (2011) these actions are the following three categories:

1. Organizational and interorganizational capital resources such as relationships with stakeholders
2. Physical capital resources such as physical equipments and technologies
3. Human capital resources such as training of workforce

Although actions mention above cannot be used separately but together as resources in order to maximize the enhancing of resiliency. According to Barney (1991) organizational and interorganizational capital resources are intangible assets of the company which means that is not physical element in a firm, such as planning and monitoring. Physical capital resources on the contrary are tangible assets such as inventory and equipment of the company. Human capital resources are intangible assets where workforces' education and training is highlighted. Yossi & James (2005) adds, that company builds resiliency by increasing flexibility or increasing redundancy. They argue, that flexibility can be raised by five elements:

1. Supply and procurement: deep relationships with single suppliers or multiple suppliers for lower risks
2. Conversion: running same management strategies in company's different locations
3. Distribution situations: seeing distribution as a possibility to enhance customer relationships
4. Systems: utilizing data and technology to get warnings in advance
5. Corporate culture: a motivated and enthusiastic workforce that follows the company's mission

Raising flexibility with elements above are seen more efficient than raising redundancy. Yossi & James (2015) suggested these five steps in a following process: supply and procurement where goods are purchased through a conversion where the same management style continues. After that happens distribution where customer relationships are highlighted. This process is supported by various technology systems in culture where motivated workforce are working towards company's mission. For one's part, increasing redundancy are most commonly seen as company keeping safety stocks in case of disruptions. In general redundancy are seen overall keeping company's resources in backup for unpredictable situations. Redundancy can be stated as some sort of insurance for a company. Reserve stocks includes, in addition to physical warehouses, storage of technology and data. According to above – supply chains' resilience consists the mix of enhances and reducers that defines company's supply chains quality. Figure 6. below illustrates the variables according to Blackhurts et al. (2011) that has an effect to resilience.
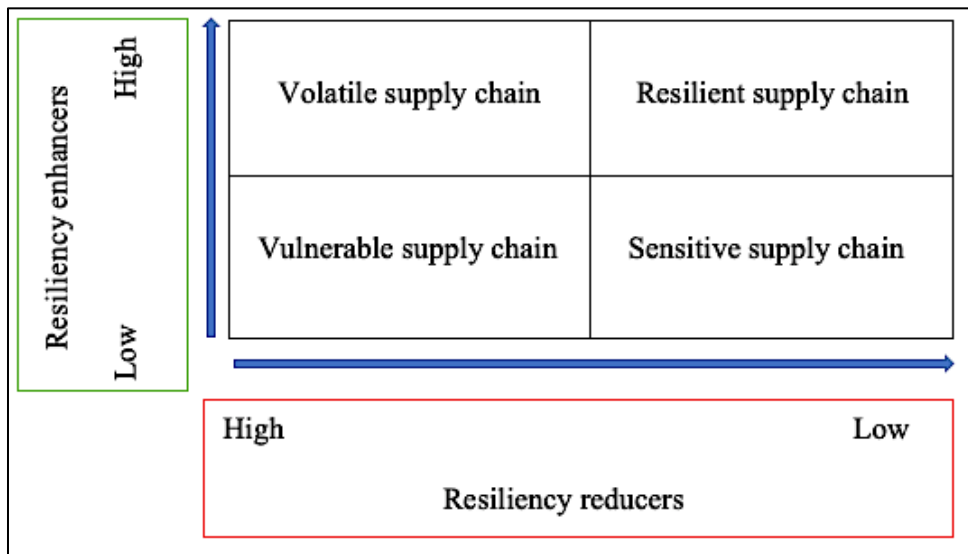
Figure 6. Supply resiliency matrix (according to Blackhurts et al., 2011)

As seen, the most vulnerable supply chain consists high resiliency reducers but merely low resiliency enhancers, this kind of supply chains are most fragile for even minor disruptions. On the contrary, sensitive supply chain consist also low resiliency enhancers but low resiliency reducers. Volatile supply chain consist high resiliency enhancers but also high resiliency reducers, which makes the supply chain uncertain and therefore difficult to manage. The most ideal situation is resilient supply chain where are high resiliency enhancers with low resiliency reducers. (Blackhurts et al., 2011.) Nevertheless resilient supply chain demands continuous monitoring and developing that further helps with possible uncertainties.

2.5   Supply chain disruption

To understand the consequence of risks to company's supply chain, supply chain disruption (SCD) needs to be defined. Supply chain disruption is the event that is caused by potential risk. This kind of event impacts always negatively to supply chain. Supply disruptions are combination of unplanned, unpredictable event in supply chain and situation that causes negative impact to the normal state of the company and supply network. These disruptions are serious situations that need quick actions for decreasing the negative effects. Effects are usually direct and indirect negative consequences for a company. (Wagner & Bode, 2008.)

Craigshead et al. (2007) adds, that supply disruption is unplanned event that disrupt the down- and upstream of the supply network in company's normal flow of materials and services. Supply disruption is often viewed through supply chain resilience and vulnerability as it is crucial how strong company's supply chain is against the disruptions.

According to definitions above, the pandemic caused global supply chain crisis as consequence of COVID-19 world faced major supply chain disruption. Disruptions included events such as delayed shipments and equipment availability problems. As Kleindorfer & Saad (2005) defines supply chain disruption can be result from natural hazards, operational distractions, political actions or terrorism. This underlines that COVID-19 can be categorized as a significant global supply chain disruption. Supply chain risks were stated earlier and according to that, supply disruptions are usually categorized to macro risks. Ivanov, Dolgui, Sokolov & Ivanova (2017) specify three disruptive levels that increase the risks, therefore company needs to consider the following levels in their operations. These levels are: production, supply and transportation disruptions. They add, that actions for mitigating disruptions are divided into two categories that are 1. active preparation and monitoring before disruption and 2. increasing reactivity and agility when disruption happens to stabilize the operations. These strategies include actions such as backup suppliers and inventory buffers to increase redundancy. Aim of these strategies is to do proactive preparation before disruptive events. Both Tomlin (2006) and Rezapour, Farahani & Pourakbar (2017) suggest also downstream supply chains extra inventory stock for emergency situations to maintain the readiness to be able to offer the finished goods.

One concept to describe disruption as a phenomenon is black swan event. Term black swan events is commonly known as term Force Majeure events that refers to environmental risks. These kind on realized risks are typically unexpected events that are hard or even impossible to forecast. In history well-known black swan events have been enormous happenings such as terrorism, wars, natural catastrophes or exceptional weather disruptions. As globalization has made global supply chains more complex, nations needs to mitigate black swan events by proactive operations. Nevertheless black swan events and its consequences are known to be difficult to estimate. (Aggarwal & Bohinc, 2012.)

Black swan is metaphor for events that are not possible – like seeing black swan. Black swan event describes well the COVID-19 and its unpredictability. Pandemic was an unknown threat that quickly disturbed global supply chains. In the next chapter COVID-19 as phenomenon is discussed comprehensively.

3. COVID-19

In this chapter the COVID-19 is presented to gain better understanding the relationship between global supply chains, SCRM and the pandemic. In early 2019 world didn't know what it will be facing at the end of the same year. COVID-19 – the unknown threat started to spread quickly worldwide from China. By March 2020 COVID-19 were found most places all over the world. In May 2022, there were over 528 million registered cases and over 6 million deaths caused by COVID-19 (Wordlometer, 2022). As Figure 7. shows in WHO's (2022) picture from December 2019 to March 2022 the cases has grown exponentially in every region. At the time writing this thesis COVID-19 isn't still completely disappeared among us – it seems that the virus will be never go away completely but it will be under control with vaccinations and by now gained knowledge of this threat.
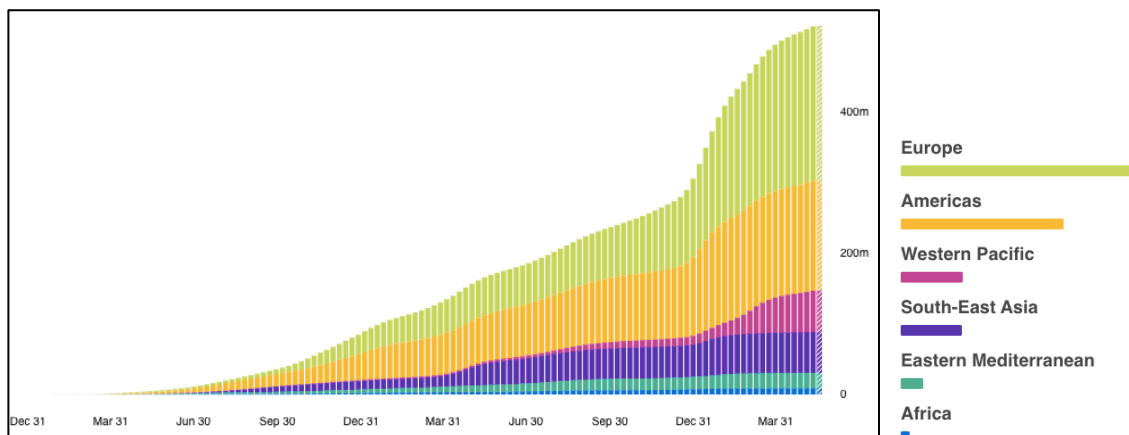

Figure 7. COVID-19 cases by regions (WHO 2022).

WHO has defined COVID-19 and the history of it as "the disease caused by a new coronavirus called SARS-CoV-2. WHO first learned of this new virus on 31 December 2019, following a report of a cluster of cases of 'viral pneumonia' in Wuhan, People's Republic of China." Virus causes various symptoms similar as flu such as fever and dry cough. COVID-19's dangerousness lies on its ability to spread much more easily than common flu. As an action for decreasing the spreading, countries started to set restrictive measures. These restrictions were most commonly limiting people's ability to move in different places outside the home. Restrictions concerned public places such as restaurants, stores, hobbies and sport activities. Most people worked from home remotely and contacts were limited besides own family. As a result of restrictions global supply chains suffered and changed from disruptions. These disruptions caused issues such as supply shortages, demand drops and inventory challenges that forced companies to replan their operations and change the way of operating in their businesses. Thus these impacts are divided in two categories in this study: economic and supply chain impacts which are discussed further in the chapters 3.1 and 3.2

3.1   Economic impact

COVID-19 has caused enormous economic impact to the globe. In history different pandemics has had a massive causation to economic stability. As stated earlier, due to COVID-19 restrictions took place all over the world. These limitations has changed the globe's economy as unemployment rate increases, market volatility is high and retail suffers as people do purchases online (BBC, 2021).

However, in Finland the situations seems to be better economically than in many other countries. Finland's Ministry of Finance (2020) has stated that the gross domestic product are estimated to decrease by 4.5 % which still is not alarming number. The decrease is explained by the factors such as unemployment rate and export. In Finland the recovery seems to be optimistic even though there are still uncertainties in the economy. The fastest recovery are expected to be in consumer goods. In Finnish companies this means positive impact financially.

As world merchandise trade fell 5.3 % in 2021 due to pandemic, World Trade Organization (WTO) (2021) underlines that it is expected to recover year by year – as in 2021 the trade was expected to be increased by 8.0 %. In 2022 the trade growth is forecasted to slow to 4 % as the total volume is decreasing to the pre-pandemic state. (WTO, 2021) As Figure 8. illustrates the world merchandise trade volume in years 2015-2022, the biggest pit is in the Q2 of 2021. After that the trend has been slowly decreased over the months.
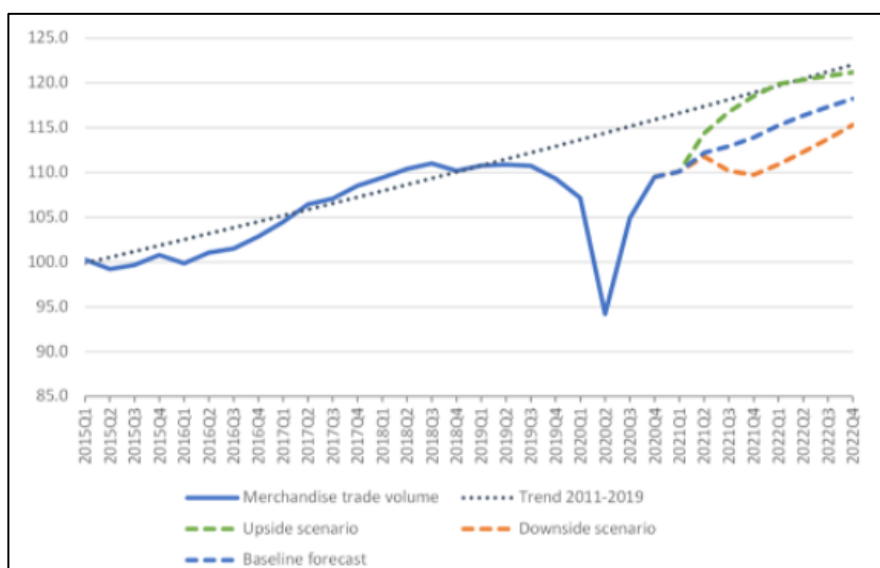
Figure 8. World trade volume in 2015-2022 (WTO 2021)

According to WTO (2021) this relatively positive outcome of world trade volume is disrupted by regional differentials, service trade weakness and delayed vaccination timetables in developing countries. COVID-19 seems to be still the biggest threat for economics though the recovery is showing positive signs nowadays.

3.2 Supply chain impact

It is obvious that global supply chains has faced enormous impact in consequence of pandemic. According to WTO (2022) COVID-19 has caused supply chain related problems such as supply- and demand pressure, shipping bottlenecks, costly freight rates and inflation that rises. WTO (2022) adds, that these kind of disruptions are risk for supply chains globally

and effects as undermining the recovery of post-pandemic time. Moritz (2020) compared traditional supply chain disruptions and COVID-19 supply chain disruptions and presented that the most important difference is human factor. This means the uncertainty of customer's behavior which affects various factors such as on demand. It causes unpredictability and fear that need to be taken care of in order to decrease the uncertainty with human factor. One way to strengthen the global supply chains is the collaboration and inclusivity between partners across regions and borders. Alicke et al. (2021) adds, that during and after pandemic, companies have increased the inventory of critical products and for example focused on nearshoring.

In Finland the same issues have been noticed. According Finland Chamber of Commerce (2021), Finnish companies has suffered problems such as lack of routes, delivery interruptions and purchasing challenges. When considering impacts globally, it seems that COVID-19 has not directly brought new problems to supply chains but revealed unseen deficiencies that already existed. Study conducted by Ernst & Young (EY) LLP (EY US) (2021) points out that companies plans to become more collaborative and agile by changing their supply chain strategies. Many companies' strategy relies on investing to new technologies such as AI (Artificial Intelligence) and at the same time investing to their workforce to gain the full potential from new innovations.

According to EY's (2021) study there were three main points that stood up of COVID-19's impact to supply chains. The respondents were senior-level supply chain executives across various sectors. This study were held to companies in the United States to organizations across many sections such as automotive and industrial. Next these findings are listed:

1. "The pandemic had substantial negative effects on supply chains"
2. "Big changes are on the horizon for supply chains"
3. "The future of supply chains is digital and autonomous"

The statements above address the main factors of the effects of COVID-19 on supply chains: negative effects, huge changes and impact to the future of supply chains. EY's (2021) study also revealed that 72 % of companies responded stated that COVID-19 caused negative effects to their companies regardless of the industry. Of that percentage

55 % of respondents reports that COVID-19 has had a mostly negative effect on their company and on the contrary 17 % responded that COVID-19 has had a significantly negative effect. Only 18 % of respondents answered that COVID-19 has not affected to their company at all. It can be stated that this EY's study is also comparable to many Finnish companies or companies all over the world as long as they are multinational and have global supply chains.

Due to disruptions and various negative effects, companies have tried to increase their resiliency against COVID-19 risks. According to related study, Shih (2020) states different ways that especially manufacturing companies have found for improving their resiliency. These contains identifying vulnerabilities and finding potential risks. This happens by various actions including: avoiding single suppliers, risk-categorizing suppliers, focusing on supplier diversity, keeping safety stocks and utilizing technology. These actions improve company's resiliency towards COVID-19 by giving flexibility to manufacturing and lowering costs.

Overall, COVID-19 has disrupted global supply chains widely and forced companies to focus on resiliency and flexibility. Pandemic has disclosed vulnerabilities that mostly already existed but never thought would be faced until COVID-19 appeared.

4. METHODOLOGY

This chapter outlines the empirical section of the research. Empirical section discusses the methodology used in this study and the research methods. Also stages of the research process are defined. After that data collection and analysis of research is explained further. The research methods' reliability and validity is also reviewed in the end of this chapter. All in all, the research is based on the discussed previous literature and studies that considered supply chain risk management and the driver COVID-19 as phenomenon. The aim of this chapter is to gain understanding of the effects of COVID-19 to the companies' supply chain risk management in purchasing process.

4.1   Research methodology and process

The choice of the research method is stated to be the first methodological choice between a qualitative and a quantitative method (Saunders, 2016). In this study the research methodology used is a qualitative method. Bluhm, Harman, Lee, and Mitchell (2011) describes that qualitative method handles questions related to explanation and description. Therefore qualitative method was the first choice for this research as the aim is to find in-depth understanding of the topic from the specialists' experiences on the field. Case study was chosen as a strategy of this research. In general, case study is the most common form in qualitative method. Yin (2003) discuss that a case study studies in real-life context the contemporary phenomenon as an empirical study where investigated phenomenon and affiliation are ambiguous. As this study focuses on impact of COVID-19, the contemporary phenomenon is obvious. Yin (2009, 4) adds, that case study is applicable way of receive depth and wide understanding of the topic studied. As Koskinen, Alasuutari & Peltonen (2015) state, in case study it is conscious choice what case to study or if there are several cases to study. In this research, four consciously selected companies are investigated to gain a deep information about topic studied.

Hirsjärvi & Hurme (2001) has created process model for academical research. This process model progress step by step when looking further for research process itself. First the research problem is defined, after that the research problem is examined further in detail level. These first two steps including defining research questions are crucial for research as it determines the direction of the whole study. The third phase is data collection and analyzing gathered data. The last phase after conducting data is to make conclusions and reporting. This process model is illustrated in Figure 9.
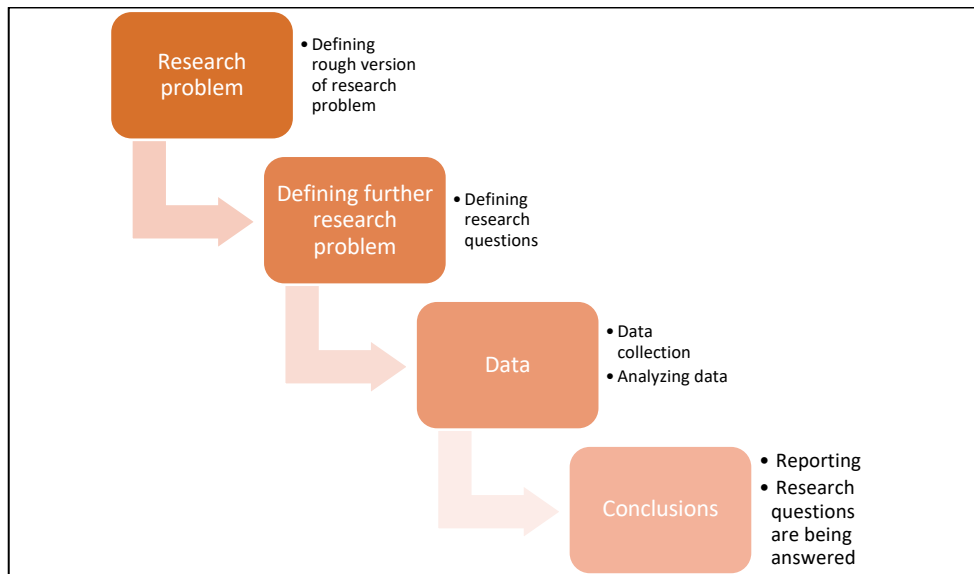
Figure 9. Process model for academical research (Hirsjärvi & Hurme, 2001)

According to Figure 9. process model, this master's thesis follows previously introduced model. The research started by rough research problem which was advanced with theoretical background and previous studies. Afterall research problem and research questions were defined as supply chain risk management and COVID-19 were well searched in previous studies although this specific pandemic is rather new phenomenon. Data was collected with semi-structured interviews as an interview method. According to Stuart et al., (2002) the importance of interview process lies on the trustable relationship that interviewer gains with interviewee. Nevertheless, data collection process is explained more comprehensively in next sections. In the final step, the data analyzed and theoretical background with previous scientific studies are discussed and conclusions are made.

4.2 Case companies

For this thesis, semi-structured interviews were held to four selected case companies. From every four case companies one company's representative participated to interview. Every representative are case company's expert in supply chain and purchasing. Interviewees' answers didn't varied much from each other so broader sample of case companies and

interviews would not bring any extra value for this study. Interviewees and case companies will remain anonymous in every part of this thesis. The case companies selected for the study are all Finnish companies with supply networks. All companies have global supply network, which means that their suppliers are all over the world such as in China and Europe. Case companies' supplier supply goods such as chemicals and components to the case companies for manufacturing. Table 2. represents the information about case companies further however still keeping the anonymity.

Table 2. Case companies

Case company	Industry	Size of the company	Interviewee Title
Company A / Interviewee A	Machinery Manufacturing	50-250 employees	Purchaser
Company B / Interviewee B	Chemical Manufacturing	Less than 50 employees	Production Manager
Company C / Interviewee C	Industrial Machinery Manufacturing	50-250 employees	Head of Production & Supply Chain Management
Company D / Interviewee D	Chemical Manufacturing	Over 250 employees	Head of Global Corporate Services Sourcing

Case companies industries and sizes varies between each other. Size of the company was categorized between small (less than 50 employees), medium (50-250 employees) and big (over 250 employees) as Appendix 1. specifies. As sizes varies it brings wider scale of impacts of COVID-19 as case companies represents then better Finnish companies despite the company's size. Common factor between interviewees are that all of them had gained several years' experience of supply chain field. Interviewees are experts in supply chain and therefore answers were also based on experience and practices through the past years. The interviewees work different supply chain positions in a case company. Supply chain environment has changed through-out the years which interviewees have experienced in

their positions, that aspect brings more value and wider perspective for this study as interviewees could gave broad insight from the topic studied.

4.3   Data collection

Semi-structured interview was chosen as a interview method for data collection of this thesis. This interviews were held in June 2022 and were execute remotely with online-meeting tool in Finnish language. Each interview's duration was 20-30 minutes and were recorded for further analysis. Data collection process started from inquiry that were sent via email to the interviewees about their willingness to participate this study. At the first email inquiry were sent to supply chain and purchasing department as intention to reach the suitable person for interview. Topic and research questions of study were presented in this specific email. After first contact the suitable time for interview was agreed rather soon. Remote interviews was chosen because of COVID-19's restrictions has shaped working culture where meetings can held from wherever regardless of the physical place. It is also usually more time-saving option than meeting face-to-face.

Semi-structured interview style was chosen for various reasons. Flexibility of semi-structured interview form was one reason for choosing it. Also research questions chosen to this thesis requires partially semi-structured style as it gives an interviewer a freedom to ask additional questions if needed and being pro-active during the interview if it is beneficial for the study. Altogether semi-structured interview proved to be optimal choice as additional questions were useful through interviews. This style provided open and trustable discussion between interviewee and interviewer. Interviews were based on supply chain risk management through effects of COVID-19. Interview questions are represented at the end of the research from Appendix 1. Questions were conducted based on research questions and providing comprehensive view from the topic focusing on purchasing part and SCRM of the companies. In semi-structured interviews recording is desirable for future source. In this research interviews were recorded with interviewees' permission for later use.

4.4   Data analysis

Data for empirical part of this thesis were gathered by semi-structured interviews from four Finnish companies with supplier networks. After interviews the primary data were processed and analyzed by data analysis model. Mentioned data analysis model process is presented in the Figure 10. According to Creswell (2009) data analysis is ongoing process throughout the research. At the same time researcher is able to collect interviews, writing notes and conducting structure for report. This model describes precisely this research' data analyzing process structure.
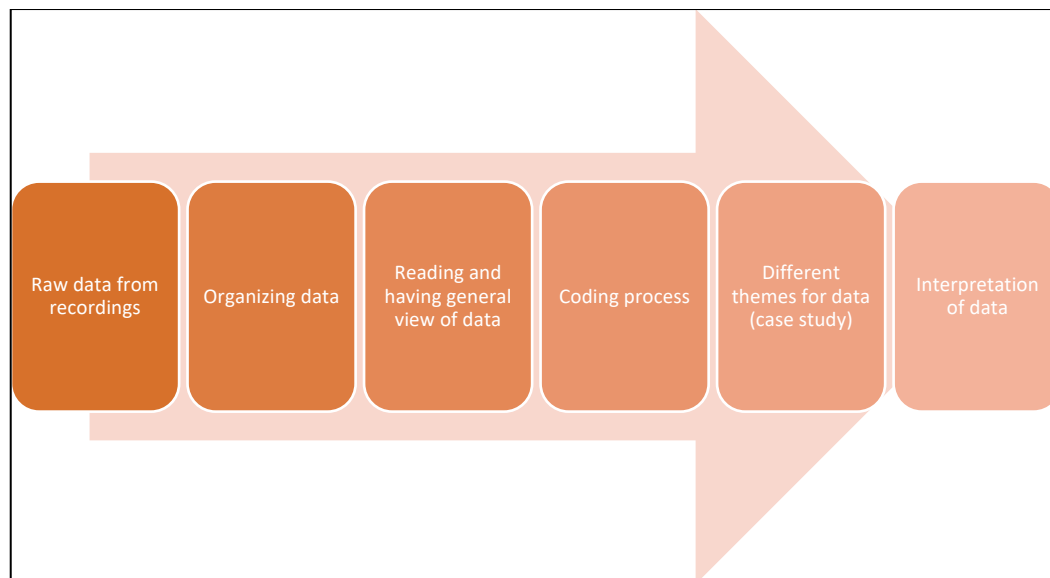
Figure 10. Data analysis in qualitative research (Creswell, 2009)

Used data analysis strategy with this presented model was content analysis which is in general the most common method for qualitative research that aim to reach truthful interpretation from collected data. As Creswell (2009) states, nowadays researchers combinates some of the qualitative strategy with qualitative data analysis to deepen the research. According to Klenke (2016) content analysis means set of procedures which help the researcher to handle massive amounts of text to informational form by identifying most important key words and themes. Bengtsson (2016) suggests four stages in this specific order for content analysis:

1. The decontextualization
2. The recontextualization
3. The categorization
4. The compilation

In practice first stage means that researcher gets familiar with the data. In this study the interviews were written open in computer as a first step of the decontextualization. In this step the data is identified in smaller units. Units are labelled in different codes that helps to internalize the content. Second stage 'the recontextualization' seeks that the aim of the study is covered in the content and requires abandoning for unnecessary information of data. In practice this happens by highlighting the most important content with the original list of units. Third stage 'the categorization' requires identifying categories where data is finding its own category no more than one group. Categorization is done when correct debriefing is done. In practice this means categorization on the basis of interview questions and literature review. The compilation is the last stage of content analysis which requires realistic conclusions of data where findings correlates with literature and results are truthful. (Bengtsson, 2016.)

After written the interviews open in text-form and analyzing it through content analysis, the specific themes were found by categorization. These categorized groups are 1. Supplier relationships of case companies 2. Risk management 3. Effects of COVID-19 4. Future of SCRM

4.5   Reliability and validity

Reliability and validity of this research is represented in this section. According to Koskinen et al. (2005, 253) both reliability and validity are in key position when focusing on the quality of the study. Semi-structured interviews can cause uncertainty about reliability and validity in general due to nature of its volatility (Saunders, 2015). Reliability stands on the probability if the similar information can be found when the study is repeated. Also

according to Eriksson & Kovanen (2008) reliability can be measured by the odds that the same outcome is achieved if the study is conducted again. Yin (2004) states the same about repeating the study but also adds, that researcher should use the same methods when repeating the study to be measured by reliability. In semi-structured interviews the complications for reliability can occur if the interviewer and interviewee brings out their own attitudes and preconceptions that would have an impact to data. That can bring instability for reliability of the study if it would be repeated in same circumstances in the future. To maintain the reliability in this study, every interview were structured same way with exactly same question form. Also interviews' recordings were reviewed the same way for each respondent.

Validity indicates how comprehensively research is accurate. The concept is discussed widely in terms of qualitative researches. According to Creswell (2009) validity in qualitative study means that the researcher use appropriate processes and tools to ensure the accuracy of conclusions of the study. One stating for validity is that it is determined by asking series of questions and seeking answers after the research (Nahid, 2003). In practice, validity demand for truthfulness of the research. In any case both reliability and validity are important factors that could not be ignored in qualitative research. As Patton (2010) notes, reliability and validity need to be considered when planning the research and analyzing it through quality. Also reliability and validity are stated to be one of the important evaluation criteria in scientifically texts (Eriksson & Kovanen, 2008). This research has been implemented trough qualitative method with semi-structured interviews. Reliability of the study was guaranteed by interviewing four different companies from different industries and interviewees in different positions. Interviews were all held in one week time frame so consistency was important to gain reliability and validity. Interview questions (see Appendix 1.) were sent beforehand via email which gave time for interviewees to prepare and think comprehensive answers for the research. If this study would be repeated the results may not vary considerably as the outcome of COVID-19 seemed to be quite similar though companies' sizes and industries varied.

5. EMPIRICAL RESULTS

The empirical analysis and results of the study are discussed in this section of the master's thesis. As mentioned, altogether four Finnish companies were interviewed for this study. Questions of the survey will be presented in four groups in this chapter. The groups are 1. Supplier relationships in case companies 2. Risk management 3. Effects of COVID-19 in purchasing 4. Future of supply chain. Mentioned groups are presented in the next chapters where questions of the survey are reviewed. The survey used for this study can be found as Appendix 1.

5.1   Supply network of case companies

Supplier relationships plays major role in case companies as all case companies are purchasing raw-materials and components from their suppliers globally. Supplier relationships are seen as vulnerable function in global supply chains. When pandemic disrupted supply networks all over the world, the relationships with suppliers were emphasized more than ever. Case companies' suppliers remain all over the world and none of them have suppliers only in Finland. This meant that a lot of consequences of COVID-19 where recognized in case companies' supply network. In Table 3. below are listed the countries where case companies' suppliers are located.

Table 3. Suppliers' locations

Case company	Supplier locations
Company A	In Europe: Finland, Switzerland Outside Europe: China, India, United States
Company B	In Europe: Finland, Netherlands, Belgium, German, Italy Outside Europe: United States, China
Company C	In Europe: Finland, Estonia, German, Italy Outside Europe: China
Company D	Operating in each region all over the world

As Table 3. indicates, majority of suppliers of case companies are located in Central Europe and in China as outside Europe. As Worobey et al. (2022) states, the epicenter of COVID-19 was in Wuhan, China in December 2019. As COVID-19 started to spread from China also the supply network related issues started to raise. Issues caused from pandemic restrictions such as human mobility and quarantine limitations leaded to manufacturing issues and logistic problems in China and eventually globally. As China is the world's leader in export the consequences to world's supply chain were enormous. In 2020 China's export was estimated to be 2.72 trillion dollars which includes all goods and services. Globally the top three countries in export are 1. China 2. United States 3. Germany (World Population Review, 2022)

All three biggest export countries above are also the main suppliers of case companies. Due to COVID-19 the disruption to supply chains were quickly noticed and the fundamentals between companies and their suppliers changed at least somehow. Remote working were natural step for communication as visiting abroad to meet suppliers were not possible. Case companies have faced several impacts for supplier relationships and communications due to COVID-19. Every case company mentioned the remote tools such as Teams or Zoom as new

way to communicate with suppliers. Communication remotely were mainly seen as negatively because of increased uncertainty when proper auditing is not possible. Interviewees felt that uncertainty has increased a lot and lot of things have to be rechecked such as delivery times and prospective delays. For example lockdown in China has caused massive effect in case company as the manufacturing stops in Chinese factory and eventually deferred order backlog moves forward causing bottleneck to harbors. This situation is unbearable for case company as it is impossible to know and predict when purchased goods will arrive.

> *"All communication takes place remotely. Information is difficult to obtain and the amount of additional investigations has increased"* says interviewee A.

Half of case companies mentioned that negative, unpredictable events has raised such as extended delivery times. This has raised the need of constant ensuring the prevalent situation from suppliers. Also Interviewee C mentioned the increased investigations because of delivery times as well as quality control is difficult to gain by remote tools. Quality control remotely are seen artificial and not proper way to ensure the quality and standards of goods ordered.

> *"There are two major problems. First of all, it is good to be able to meet new suppliers face-to-face, which has naturally been challenging due to the COVID-19. Secondly, the biggest problem is quality control, which have not been possible to do with normal checkups by visiting to suppliers."* says interviewee C

As remote tools have been seen as a negative for suppliers' auditing also positive impacts have been noticed by reduced possibility to meet face-to-face. One case company's representative mentioned that with remote communication there have been positive impact for collaboration and relationship between case company and suppliers.

> *"Cameras have been the key in order to create good connection with the suppliers. In some cases there actually have been even more collaboration as*

also the more traditional suppliers have been forced to adopt into new ways of working." says interviewee D

Although also positive effects were recognized the major opinion were that lot of negative impact have occurred when asking the consequences of COVID-19 to supplier collaboration. Even changing the suppliers has come into question when collaboration has not worked as expected. Case company B switched supplier when they noticed delivery difficulties due to previously ordered raw-material. New supplier where found from Europe.

"Some long-term suppliers have been abandoned due to difficulties. Luckily we found new supplier from Europe. That was so called emergency situation." says interviewee B

All in all, relations with suppliers have partly become more difficult because there has not been possibility to visit the suppliers. Although many cases can be handled remotely, there are still need to handle certain functions face-to-face, such as supervision and quality assurance, i.e. general monitoring, which is difficult to implement via video remotely. Basic functions such as inquiries, receiving offers, ordering, handling materials and invoicing are managed remotely effortlessly mainly as before. On the other hand interviews pointed out that additional inquiries to suppliers have increased as uncertainty is prevailing. However, long-term cooperation and case-specific negotiations would require meeting face-to-face by visiting to suppliers despite their location.

5.2 Effects of COVID-19 in purchasing

Case companies are all manufacturing various goods for their end customers. As stated earlier, two of case companies industries are chemical manufacturing as one is producing machines and the fourth one industrial machines. According to Bank of Finland Bulletin (2021), especially metal- and chemical industries in Finland are the most vulnerable for supply chain disruptions. These kind of businesses, which also case companies represent, suffer from material shortages more than others. COVID-19 caused extensive supply chain disruptions that effected purchasing companies various ways as these companies are usually

dependent on foreign inputs. As case companies need components and necessities for their manufacturing production, they purchase needed goods from their suppliers. In Table 4. below the purchase types of case companies are listed.

Table 4. Case companies' purchase types

Case company	Purchasing
Company A	electrical components, metal components, rubber, plastic, welding assemblies
Company B	solvents, valves, nozzles, plastic caps, raw materials, paints
Company C	mechanical components
Company D	raw materials such as chemicals

In the data collection form was asked how COVID-19 has effected to company's purchasing process in practice. Interviews underlined that COVID-19 has had an enormous effect to case companies purchasing. All case companies highlighted many negative consequences and none of interviewees didn't mention any positive outcomes that pandemic has had when it comes to purchasing. These disruptions are listed in Table 5. below. As mentioned earlier, due to pandemic companies with global supply chains have suffered from disruptions as many businesses are dependent from other companies production and labor input in the supply chain. Therefore majority of business are vulnerable for disruptions when it comes to any part of their supply chain.

Table 5. Disruptions on purchasing due to COVID-19

Case company	Disruptions on purchasing due to COVID-19
Company A	delivery delays, material shortages, price increase, trust issues with suppliers
Company B	delivery delays, material shortages, price increase
Company C	delivery delays, material shortages, price increase, increased delivery time for customers
Company D	delivery delays, material shortages, price increase, increased delivery time for customers

All four case companies mention various effects of COVID-19 to their purchasing. However, two main effects due to COVID-19 raised. These negative consequences to purchasing are 1. Extended delivery times causing shortages 2. Price increase. Other effects were also mentioned such as that suppliers have even utilized the situation and delivered goods late blaming the COVID-19 though as matter of fact the reason is something else.

> *"I feel that COVID-19 is easily pleaded as excuse so that, for example, fines for late components do not have to be paid. This causes more delays due to COVID-19 and other unexplained reasons."* says interviewee A

Interviewee B mentions that usually their suppliers delivery times are approximately four to five weeks and during pandemic the delivery time has increased to seven to even eight months. Interviewee D tells, that delays in components means much longer delivery times in company D. Also interviewee C states that suppliers' delivery times have increased which means in their company double or even triple time for standard component. Naturally this

brings difficulties to deliver the final product to customers whom are expecting normal, previously agreed delivery time.

> *"Delivery times have grown considerably and become difficult to predict, that has been surprising especially for specific components. For example, if one component comes from China, the availability of which is poor, then the availability of the entire final product depends on it."* says interviewee C

When it comes to price increases, all interviewees mentioned it somehow. Interviewee D summarized price increasing that costs are not in control and overall it is very cumbersome to forecast any price development. Price increase has been constant from the start of the pandemic. Part of case companies are doing project-based business as they deliver final product when project is agreed with customer beforehand. In practice this means that project is agreed with specific price and schedule. Due to COVID-19 price increases the manufacturing company are eventually taking operating loss as the prices are not predictable and suddenly increases. All case companies stated that they have not had large inventories for production thus usually all components are ordered for the current need from suppliers. Altogether interviews pointed out the difficult situation regarding price increases.

> *"The price increasing has been continuous. We are not talking about small increases now as I mean 10 % and 15 % increases regularly since COVID-19 started. The increase in prices is directly out of our profit in the end."* says interviewee C

Both extended delivery times and increased prices causes negative consequences to case companies which mean in practice shortages in components, unpredictable costs and harm in usual business.

In interviews case companies were asked if there have been made any changes to company's purchasing process due to COVID-19. All interviewees mentioned some changes and new habits that have been adopted as a consequence of pandemic. This habits are things that have been adopted before and are more comprehensively used now or totally new innovations and activities that have been raised to mitigate the negative effect of COVID-19. All case

companies mentioned that communication with suppliers has grown and the importance of inquiries has increased.

> *"More than before, there are constant monitoring and regular meetings in Teams with head-suppliers that there would be up-to-date information all the time and there would be fewer surprise to us"* says interviewee A

> *"I am often in contact with suppliers, if not daily, then several times a week. They must be tired of me being in touch all the time."* says interviewee B

In practice communication means more meetings with suppliers and inquiries to gain the real-time information. Altogether changes in case companies purchasing process are listed below in Table 6.

Table 6. Changes in purchasing process due to COVID-19

Case company	Changes in company's purchasing process due to COVID-19
Company A	- reducing single sourcing - more alternative suppliers - increased communication with current suppliers
Company B	- increased communication with current suppliers - more acuity to raw-material/component orders
Company C	- increased communication with current suppliers - designing alternative options for current components and suppliers - avoiding certain supplier countries - the importance of cost efficiency has increased
Company D	- increased communication with current suppliers - more focus on data and information sharing

Case companies are forced to do some changes in their purchasing process to reduce negative the impact of COVID-19. Interviews highlighted changes besides increased communication

such as: reducing single sourcing, finding alternative suppliers, acuity to orders, avoiding countries with supply issues, minimizing costs and focusing more on shared data. Therefore noticed changes can be divided into internal and external drivers due to its nature.

As mentioned earlier, price increase and increase in delivery times were the biggest effects in purchasing due to COVID-19. Company C tries to avoid these by finding alternatives for components and/or suppliers and therefore making changes to its purchasing process.

> *"If it is known that a certain type of product or supplier has either an increase in price or an increase in delivery time, we try to think in advance whether it is possible to switch to a completely different type of solution in order to get rid of this problem or at least switch to another supplier"* says interviewee C

Also company A tries to find alternatives and mentions that they are trying to get rid of single sourcing. By single sourcing it is meant that one single supplier supplies components to case company. This can be risk as purchasing is trusted to one supplier that may not be able to purchase the ordered goods – in this case due to COVID-19. Interviewee C states similar kind of opinion saying that their company avoids purchases from specific country that can be potential pitfall. Interviewee C adds, that in this case the risky country is China due to difficulties in supply and their aim is to find new supplier from Europe. This change to geographical purchasing lowers the risks from shortages.

None of the case companies mentioned new innovations or, for example, the use of artificial intelligence that would have been utilized as the driver of COVID-19. Interviewee A said to this topic that their company is rather small business that artificial intelligence is not necessary for their company as their processes are manually operated. Interviewee D commented to this aspect that digitalization and new tools for supply chain are coming anyways so it is something that will happen with or without COVID-19. All in all COVID-19 has driven case companies to make various changes to purchasing process to keep purchasing agile and functional. Changes are rather operational in every case company and any big innovations or new systems have not been yet planned or adopted.

5.3 Risk management

The interviews covered the risk management of case companies. Risk management was considered by supply chain and purchasing point of view. Risk management is huge part of companies strategy as it can be seen as preventive process for prospective risks. With constant supply chain risk management (SCRM) company identifies and mitigates possible risks of supply chain. Global supply chain has brought more possible risks as supply chains are more complex and vulnerable than before. COVID-19 pointed out the vulnerability in businesses supply chains though risk management would have been implemented. Supply chain risk management does not eliminate the occurring risk but can mitigate the impact of it. All case companies have some kind of risk management in their supply chain process, other less than others. Case companies were asked from supply chain risk management as the time before COVID-19 and the changes on it because of COVID-19. Interviews pointed out that the scope and style of risk management varied depending e.g. from company's size and industry.

5.3.1 Before COVID-19

Respondents were asked what kind of risk management was used for the company's supply chain and purchasing process before the COVID-19. Interviews highlighted that case companies' SCRM varies a lot from each other – as some companies have minimalistic SCRM actions and others more advanced strategies.

> *"We have a really small purchasing and sourcing organization, so we don't have that kind of official risk management for it. I would describe it as more experience-based SRCM. Therefore our company's risk management is small-scale and still developing"* says interviewee A

> *"We have general risk monitoring on a corporate level where all risks are identified, classified and tracked. Also risk control measures are being decided: avoid, accept, mitigate, transfer. In purchasing we have risk management application which is tracking risks globally. We utilize this risk*

data in the sourcing strategies especially for the direct sourcing of raw materials" says interviewee D

Respondents answers underlines the difference in SCRM when it comes to company's size. As company A is rather small organization with 50-250 employees whereas company D is big multinational company having suppliers in each region all over the world. In general bigger companies has usually more comprehensive SCRM as their supply chain are more complex. Regardless of the size of the company, safety stock is one way of SCRM. Safety stock or so called buffer stock is company's way to handle unpredictable rise in demand or delays in supplied goods. Safety stock means extra inventory of goods or raw material kept in warehouse. According to Buzacott & Shanthikumar (1994) extra stock in warehouse lowers the risk of stockout. On the other hand high inventories leads to higher costs. However, interviews revealed that safety stocks are usual method for SCRM.

"It is important to us to buy goods and extra raw materials for the buffer warehouse, when it is known more precisely what is consumed all the time and what needs to be kept in stock just in case" says interviewee B

Besides safety stocks, case company C mentioned same as case company A as they are trying to avoid single sourcing which has been procurement for SCRM also before COVID-19. In practice this means that there are various suppliers available for specific components and also alternative back-up suppliers.

"There are several subcontractors for all purchasing product groups, so we try to avoid not being dependent on one supplier" says interviewee C

Suppliers are often being monitored by companies. Constant monitoring and auditing arose from interviews as one way of handling SCRM. These activities are done to reduce the surprises of suppliers and ensure that their businesses are stable and trustable. Evaluation are done usually beforehand when choosing suppliers and also regularly during supplier relationship.

"In our company, suppliers are evaluated in advance and regular audits are carried out, continuous quality assurance is also important. Certain checks of suppliers' financial situation are carried out, which has become even more critical during the COVID-19. This has also been done for new suppliers before the pandemic." says interviewee C

Altogether interviews pointed that risk management for purchasing before COVID-19 has varied a lot between case companies as some of them had more advanced operations than others. All case companies had some sort of SCRM in use that has helped with COVID-19's caused disruptions. Case companies' used SCRM are listed below in Table 7.

Table 7. SCRM before COVID-19

Case company	SCRM before COVID-19
Company A	- not official SCRM in strategy - SCRM is based on previous experience - supplier monitoring - avoiding single sourcing
Company B	- buffer inventory - supplier monitoring
Company C	- avoiding single sourcing - supplier monitoring and advance assessment
Company D	- general risk monitoring on a corporate level - risk management applications - safety is regarded as part of SCRM - segmentation which trickers actions based on priority and criticality

As listed above in Table 7. avoiding single sourcing and supplier monitoring are the most common SCRM methods in case companies. Other used practices are buffer inventory, risk

management applications, safety actions and segmentation for different potential risks. SCRM seems mainly been the same in case companies before COVID-19 than during the pandemic. Through interviews it became clear that all case companies' think that SCRM is needed despite the scope it has been harnessed in case companies.

5.3.2   Changes due to COVID-19

As COVID-19 has effected widely to global supply chains, all case companies have recognized some changes in their businesses. As COVID-19 is still present at the time writing this master's thesis, the effects can't be comprehensively seen yet. Respondents were asked if COVID-19 has brought any positive impacts to supply chain risk management and if yes – what these impacts are. Even if effects of COVID-19 are seen mainly negative, interviews raised also some positive effects of it. Some of case companies were a bit suspicious but respondents found at least something good in their opinion. Company A, B and C mentioned positive outcomes. Company D didn't mention any positive changes, as respondent D said that COVID-19 hasn't brought major positive changes. Many companies found that the positive thing is that in generally companies can better prepare for the future knowing that major disruptions are possible after pandemic.

> *"Maybe we have noticed that anything can happen, so we can better prepare for the future and recognize potential threats. In general, after COVID-19, we know better what can go wrong. I've been in the same business for a long time and I've never come across anything like this. Surely something has been learned from this – which is positive"* says interviewee A

Company A's respondent stated as positive impact that company has noticed that warehouse stocks should not keep low. With COVID-19 it has been noticed that it is not the best option to keep stocks at zero. Before COVID-19 it was rather a goal in a case company A. Instead company B has noticed as a positive impact that new suppliers have been found that would not have been happened without COVID-19. This is a result of component shortages that many companies suffered due to pandemic.

"Our company has gained new contacts. For example, we have established contact with European supplier with whom there has been no cooperation before and, on top of that, we have received a lot of help from them" says interviewee B

As COVID-19 forced people to work remotely and change their working habits the new tools and technology have been harnessed inevitable. Without pandemic it can be stated that this kind of leap in technology would not have been taken yet. Remote working has also lead to a decrease in business travel which leads to cost reduction. Company B mentioned both aspects and highlighted that communication is partially even better now than before pandemic.

"Yes, there are some positive aspects in negative things. Teams (the business communication platform) procedure is good when you don't always have to go and sit in the same conference room. With this, communication has increased and it is easy to catch up with people from a distance. Communication has therefore become more efficient. In addition to this, the company's travel costs have decreased." says interviewee C

Altogether many positive aspects arose from interviews. In Table 8. below the main impacts of pandemic are listed that have been noticed in case companies. These impacts are better communication with suppliers, decreased travel costs, new suppliers, more comprehensive supplier monitoring and all in all better preparation for the future. As the COVID-19 has been big challenge for many businesses, nevertheless these are some desirable result due to pandemic.

Table 8. Positive effects of COVID-19 on case companies
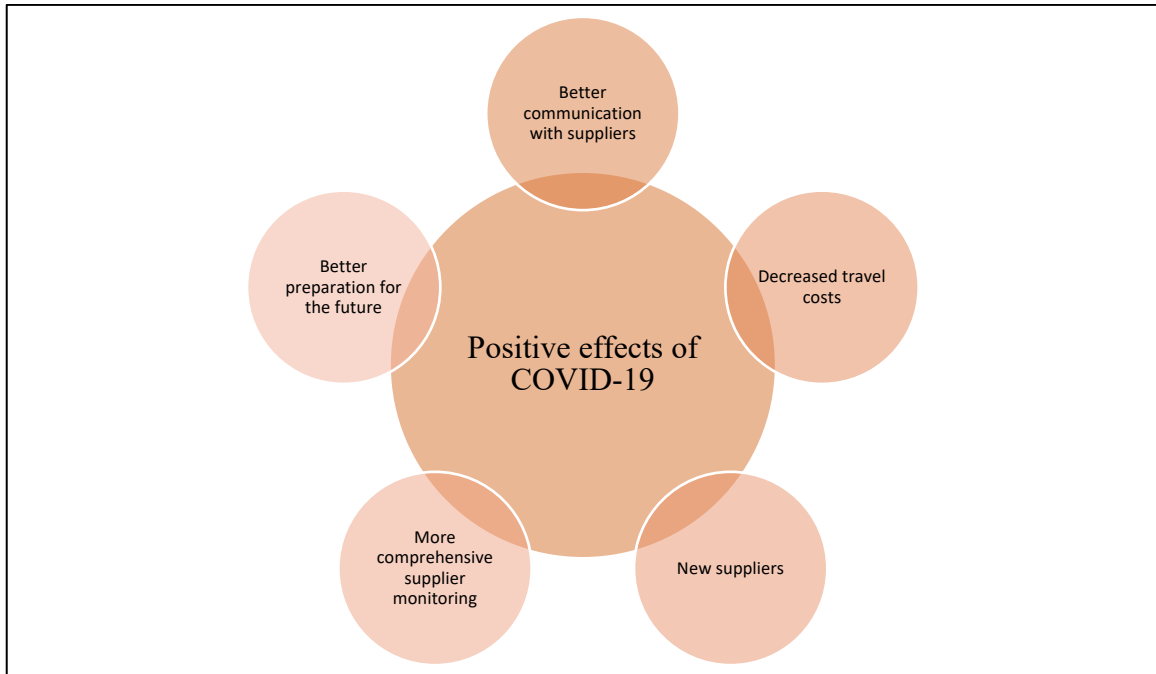
Along with positive impacts respondents were asked if COVID-19 has changed anything permanently in supply chain risk management. By this question respondents were asked their personal opinion of the subject. As pandemic caused extensive impacts and changes to supply chain risk management it can be stated that something usually changes permanently. It became clear from interviews that not all the effects of COVID-19 can be see yet as companies are still recovering from it. Some consequences may take time to see what have been learned. Interviewees brought several thought of their opinion what are changed permanently in SCRM. The most common answers was that due to COVID-19 more attention will be paid to risk management and preparing that something similar might happen in the future.

> *"It has certainly been noticed that there will always be something in the future that will have a big impact on businesses and SCRM. I would personally hope that more attention is paid to risk management. All in all, it's a bit difficult to say the effects yet."* says interviewee A

"It has been noticed that big global changes can happen in months and even days. That's why it has changed, that you can't be lulled into thinking that everything will stay the same. Instead, you have to be awake and prepared for everything" says interviewee C

"COVID-19 only underlines the importance of risk management. Risk management in general is a topic that won't be going away from companies' radar" says interviewee D

Besides increased attention to risk management, COVID-19 might have effected to price level, according to interviewee B. As pandemic has destabilized the global supply chains causing bottlenecks and component shortages, also prices has increased in an unprecedented way. It may be difficult to estimate the price level of components and raw material at this point but companies have noticed the trend and fear is that it could be permanent situation. The increase in prices was brought up many times during the interviews, despite the question being discussed. Therefore it is accurate to denote that price increase are so far seen as permanent situation.

"The price level for raw materials has changed permanently, it's tough. Some products may have a price increase of more than 200%" says interviewee B

All case companies have noticed changes in SCMR due to COVID-19. Interviews highlighted that bigger companies have not noticed equally massive effects than smaller companies. This statement is supported by the fact that case company D is the only company of sample with more than 250 employees. As interviewee D mentioned, bigger changes, whether positive or permanent, have not been noticed. Nevertheless case companies underlined the significance of SCRM which is paid more attention nowadays and in the future.

5.4   Future of supply chain risk management

The interviews covered the future of supply chain risk management. As mentioned above, interviews highlighted the importance of SCRM. Global supply chains are complex as supplier relationships are expanded all over the world and companies' supply chains are longer than before. Interviewees were asked which do you see as threats to the risk management of the company's supply chain in the future. The answers were based on the respondents' own assessment of future threats. This question many interviewees found difficult to answer as the future seems to be uncertain. Interviewee B stated that in general, the global supply chain brings more and more threats. Interviewee A pointed out that sea freight is going to be a big bottleneck, availability is poor of raw-material and prices will increase as there are more shortages. Also interviewee C brought up the overall uncertainty in the world as well as the prices in the future. Interviewee D mentioned also the geopolitical changes that will be threatening for businesses. By geopolitics is meant things concerning the whole world such as trade, war or climate agreements.

> *"The geopolitical situation brings uncertainty and general uncertainty grows. Such factors include e.g. the price of energy and various sanctions. With this, it is not possible to predict what will happen to prices in terms of energy, freight and raw materials"* says interviewee C

> *"In general geopolitical changes are threat in the future. For example changes in exports or customs"* says interviewee D

Altogether it can be stated based on interviews that the world's situation is worrying regarding the SCRM. With geopolitical factors, another threat seen in the future are natural hazards. Natural hazards are commonly known as natural phenomenon that causes negative effects. Example of natural hazards are earthquakes, heat waves and hurricanes. Because of climate change these hazards occur more often. The concern is therefore justified and cannot be underestimated regarding to SCRM as both geopolitical factors e.g. regulations and natural hazards are external factors that companies themselves cannot influence. Internal

factors are threats that company can affect itself. Interviewee D raised a point of view that focus on company's planning that can also be a threat itself.

> *"From a company perspective there can be a simple thing like budget and how much spend is put to safety stocks. In general how to define critical spares in the first place as nearly all components etc. are suffering delivery delays"* says interviewee D

In relation to inventory management, a major threat factor is also perceived to be the continued component shortage. This threat will affect company deliveries in the future.

> *"Most of the components come from Asia, which could be said to be a threat in the future. The component shortage has an insane effect on all deliveries. For example suppliers have said delivery that delivery time is 15-28 weeks, so it's hard to plan anything"* says interviewee A

The threats revealed in the interviews are listed below in Table 9. Threats are categorized to internal and external threats due to nature of the threat: whether it is coming inside or outside of the company. Overall the interviewees worried the most about uncertainty in the future which includes geopolitical situation and changes globally.

Table 9. Future threats to SCRM

|	**Future threats to SCRM**
Internal threats	- budget - inventory management for critical spares
External threats	- geopolitical agreements - natural hazards - the world's uncertain situation

In relation to the future, the interviewees were finally asked what they think SCRM will look like in the future. The purpose was to cause reflection on whether it will change much from the current situation and what these changes will be. Interviewees pointed out that sustainability will be highlighted even more in actions in the future. Sustainability are seen as companies competitive advantage and as a mandatory requirement.

> *"Sustainability and quality standards must be in place in the company's operations. The issue is so much on display that especially the bigger companies cannot ignore it. If you don't pay attention to those things, someone else will"* says interviewee A

> *"Sustainability is more strongly present due to customer demand. Environmental factors, not commercial factors, will affect the SC"* says interviewee C

In addition to sustainability, the interviews revealed the role of data in the future. All case companies mentioned the role of data and its utilization in the future. With help of data companies are able to predict and analyze risk information better. For its part, information technology has developed further during the COVID-19 but it is seen to develop and continue its course even further. The interviewees' thoughts about the future are listed in the Table 10.

Table 10. Future of SCRM
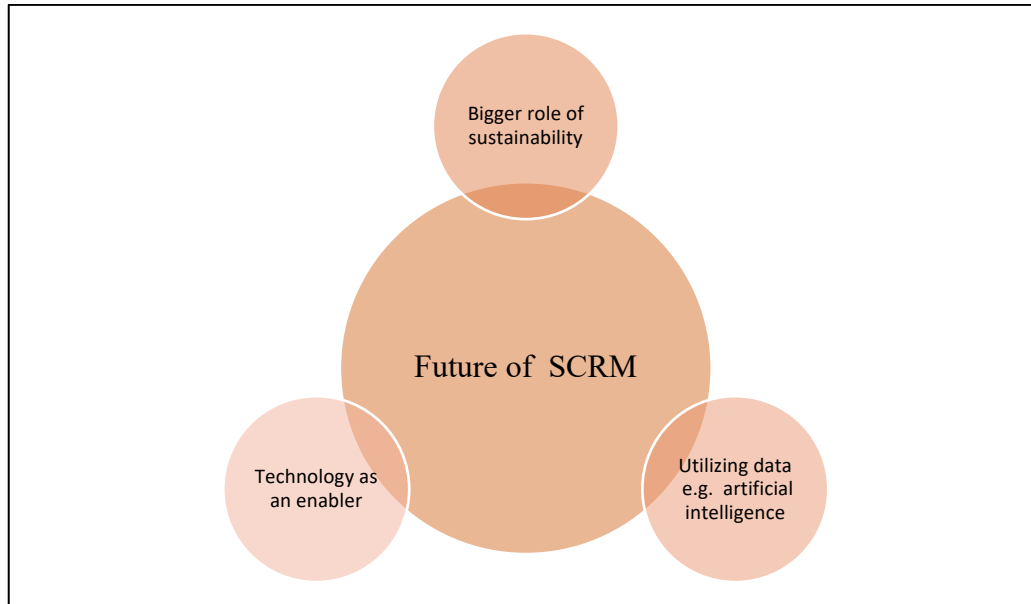
"In order to meet the demand, forecasting must be increased. Therefore, more predictions will be made in the future" says interviewee A

"All innovations, artificial intelligence and data are utilized more. Our company has also talked about it and is using it in some way, it will definitely develop more and automate things more" says interviewee B

"...artificial intelligence, various applications, the use of information technology, the development of all this has of course accelerated during the COVID-19" says interviewee C

"Data is playing a bigger and bigger role. Making sure data is correct and in correct location - typically somewhere in Cloud. For example it's not enough to map a supplier but there needs to be an understanding throughout the supply chain." says interviewee D

The future in post-pandemic world is largely seen as full of uncertainties due to geopolitical changes, regulations and how companies themselves manage to make right decisions

internally. However, the utilization of data and technology is seen as strong in the future, which will help companies manage their supply chain and also predict potential risks for the business.

6. CONCLUSIONS

In this research the impact of COVID-19 to SCRM is examined through four Finnish case companies. This chapter presents the solutions that are based on previous covered literature and a case study of four companies with global supply network. The main research question and sub-research questions are answered in this chapter as well as the suggestions for future research are proposed.

6.1 Discussion of the research questions

The aim of this study was to find how COVID-19 has affected to supply chain risk management in Finnish companies. This was held by purchasing point of view. Purpose was to find out what kind of risks are noticed in companies and how these risks due to COVID-19 are reduced. As basis of this study is used previous researches and literature of SCM and SCRM as well as COVID-19. In this research the qualitative method are used, and the analysis as well as the results are based on collected data from four semi-structured interviews. The structure of the answers are conducted in the following manner: first both of the sub-questions are went through one after the other and finally the main question of the research is answered.

What kind of supply chain disruptions have been detected in companies because of COVID-19?

Due to COVID-19, various supply chain disruptions have been noticed as consequence of realized risks. The pandemic has revealed the vulnerability in companies supply chains as it was unpredictable and unknown threat. The study underlines that COVID-19 has caused several supply chain disruptions to companies and tested supply chain resiliency. Case companies were interviewed from disruptions by as asking negative consequences of COVID-19 from different aspects. Empirical study revealed that all case companies have noticed various disruptions because of COVID-19. Pandemic have brought negative effects widely and all of the case companies has suffered from it. Two major disruptions in supply

chains effecting to SCRM were noticed as extended delivery times and price increase in purchased raw-material and components. Due to these disruptions companies have suffered from raw-material shortages, delays in components and uncertainty in their SCRM such as the impossibility of predicting costs and planning.

These empirical findings are supported by the theory of Blackhurts et al., (2011) that specific factors reduces supply chain resiliency. These factors are activity flows (e.g. transportation), unit flows (e.g. manufacturing) and source of flows (e.g. suppliers). Company's resiliency is reduced when these flows are altered with unexpected events that interrupt the normal flow. Various authors has defined as well as Menzer et al., (2001) that SC is a network of different stakeholders working together to provide smooth flow for materials. Based on interviews this smooth flow has been disrupted by COVID-19 in every part of supply chain, from suppliers to transportation to manufacturing.

How companies have reduced disruptions caused by COVID-19?

During COVID-19 companies have tried to mitigate and reduce several SC disruptions. Interviews revealed that before COVID-19 case companies' SCRM varied from each other as other companies had more advanced SCRM than others. Half of the companies mentioned that they execute SCRM strategy including general risk monitoring and other half did not recognized official SCRM in company's strategy and described that SCRM is still developing strategy in company's operations. However, every company mentioned some actions that were utilized before COVID-19 to reduce potential risks such as general supplier monitoring, avoiding single sourcing and buffer inventory. With these actions companies managed SCRM before COVID-19 existed.

When COVID-19 were realized and disrupted companies supply chains, various actions raised in aspiration to reduce disruptions due to COVID-19. As Jüttner (2005) and Tang (2006) have stated, SCRM is a process aiming to low vulnerability and increase smooth flow in supply chain's. Interviews stated that this was case companies mission as reducing disruptions caused by pandemic. Companies SCRM actions during COVID-19 are related to suppliers, cost efficiency, data utilization and focusing on precision in raw-material/component purchases. Actions related to suppliers were the need to get rid of single

sourcing and focusing on nearshoring. By these actions companies ensure that they would have more alternative suppliers and at the same time avoiding certain countries that were noticed to have supply problems such as China and finding new supplier closer in Europe. This is supported by the study of Lin et al. (2021) where they state that variety in suppliers helps company to increase resiliency. Every case company stated that they have reduced disruptions by increasing communication with suppliers. This has meant more rechecking as well as increased monitoring and supervising suppliers. When companies have suffered from delays and shortages, paying more attention to components and raw-materials have increased. This means actions such as increased acuity to orders and planning alternative options for needed components, also company's buffer inventory has risen to an important role. As companies have suffered also from cost increase, they have tried to pay more attention to cost efficiency in their operations. Also general information sharing and focusing on data have played bigger role in case longer absences in the company. Data is needed to be available for anyone as one SCRM action to prevent interruptions in information flow.

In literature there are suggestions for reducing disruptions. Dolgui, Sokolov & Ivanova (2017) suggests two strategies for mitigating disruptions. These are actions before disruption as active preparation and secondly enhancing agility and reactivity when disruption is realized. They add, that these main strategies include actions such as monitoring, finding alternative suppliers and focusing on safety stocks. Mirroring data gathered from interviews, it is clear that case companies have followed these strategies as there have been preparation beforehand such as supplier monitoring. Also when disruptions happened companies have been done proactive mitigation as trying to avoid single sourcing, finding new suppliers and managing buffer inventory. However, there have been dispersion between case companies as others seemed to have more advanced strategies for reducing disruptions than others. This is explained by the variation in the size of the companies. Nevertheless every company has been done actions to reduce disruptions.

How COVID-19 has affected to supply chain risk management in Finnish companies?

COVID-19 has been a huge actor on companies' operations, including SCRM. Various authors such as van Hoek & Dobrzykowski (2021) and Lin et al. (2021) has stated that

COVID-19 has had an enormous effect on companies supply chains which supports the conclusions of this study. Due to supply chain effects companies had to rethink and reorder their SCRM. Effects of COVID-19 are seen mainly negative due to the disruptions it has caused. Companies have tried to mitigate the negative effects by reducing disruptions in various ways. However, some positive outcomes are also found. Due to COVID-19 positive impacts to SCRM are related mainly to suppliers. Supplier relationships are seen better now as communication has increased, suppliers are being monitored more and new pleasant suppliers have been found. Overall as an positive effect of COVID-19, companies' state of will is to be better prepared for the future.

The purpose and goal of SCRM are defined by Zsidisin & Ellram (2003) as eliminating potential risks. Manuj & Mentzer (2008a) adds that cost-effectiveness if crucial element when defining SCRM. Companies implement SCRM in their operations but it is affected by COVID-19 although the purpose has remained the same. Interviews proved that when hazards appears, it effects enormously to companies supply chains and operations around it. This means that the unpredictable events changes company's SCRM as the effect of COVID-19 has reshaped supply chains and SCRM permanently. The study raised the importance of SCRM due to COVID-19 as the companies have paid more attention to it. This is supported by the study of Ernst & Young (2021), where they indicate that companies ambition is to be more collaborative and agile when focusing on their SC strategies after COVID-19. Price increase as other effects are seen to be permanent and at least the prices of raw-material will not drop to the pre-pandemic level. Nearshoring is certainly partly came to stay as new advantageous suppliers have been found from geographical location which are nearer to companies' operations. Also avoiding single sourcing was clear action to SCRM comparing time before pandemic. Supplier diversity in as SCRM is supported by study focusing on COVID-19, where Lin et al. (2021) states, that companies with alternative suppliers and with different locations are advantageous for companies when disruptions occur.

Overall attitude towards the future and uncertainties also affects companies' SCRM because COVID-19 has shown that anything is possible and things don't necessarily stay the same. Bigger companies whom have had focus on SCRM already in pre-pandemic time, do not recognize big changes in SCRM as clearly as smaller companies with SCRM not in a key process of company. It is studied by Alicke, Barriball and Trautwein (2021) in their survey

that 59 % of companies have utilized new SCRM practices due to COVID-19 including totally new practices and also focusing on strengthening the current ones. Altogether 95 % of companies recognized formal SCRM in their company's strategy. This supports this study as almost every company mentioned SCRM in their operations and also the willing to focus more on it because of COVID-19.

The effects on the future may be even more far-reaching. At the same time future of SCRM are seen uncertain due the future threats such as geopolitical decisions and changes. On the other hand COVID-19 has sped up for its part the development of technology and its utilization SCRM. It is seen that the role of data is highlighted in SCRM in the future. Also sustainability actions cannot be forgotten in SCRM. In the future companies are required to take sustainability as a bigger part of their SCRM operations such as focusing on quality standards and responsibility to identifying every supplier in their supply chains. Altogether COVID-19 has affected to SCRM widely, not only present but in the future also. Consequences can be seen comprehensively in upcoming years as time will tell how the SCRM are reshaped.

6.2   Suggestions for future research

At the time writing this study, COVID-19 is rather new topic and companies are still partly recovering from it. It seems that the virus will remain in the world among people and is controlled by vaccines. Global supply chains and SCRM have changed and also manner of operating in companies. Therefore further research could be done in the future with the same topic. This would indicate how companies experienced the situation in post-pandemic world years from now. This kind of study would reveal how companies perceive the effects when years have passed from COVID-19 and which things have come to stay permanently in their operations from SCRM aspect. This could also be expanded to concern some other part of business operations to have different perspective of COVID-19's effects.

This study was composed as qualitative study with four semi-structured interviews. Different point of view would be bigger sample and conducting the same study in quantitative method. Wider sample would give more data from the topic researched and new perspectives to it for the future research. Although it can be assumed that the answers will remain similar, there

may still be dispersion depending on the size of the companies studied. Also different kind of industries would give a new viewpoint for the study. Industries such as retail, health care or construction business would be interesting to study as their aspect could be totally different.

This study also revealed the meaning of data in SCRM. Technology and data are seen in bigger role in the future so it would be interesting to study extensively the signification of data especially after COVID-19 in companies SCRM operations. How technology will develop and especially how it is utilized in companies.

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Appendices

Appendix 1. Interview questions

1. What is your position in the company?
2. What is the industry of your company?
3. What is the size of your company?
   small – less than 50 employees, medium – 50-250 employees,
   large – over 250 employees

4. In which countries are your company's suppliers located?
5. How has COVID-19 affected relations with suppliers?
6. What kind of purchasing does your company do?
7. How has COVID-19 affected negatively the company's purchasing?
   If so, what kind of disruptions have occurred?

8. Have there been any supply chain risk management before COVID-19?
   If there have been, what kind of?
9. Have changes been made to the company's purchasing process/supply chain due to the COVID-19? If so, what new methods have been used?
10. Has COVID-19 brought positive effects to the supply chain risk management?
    If so, what kind of?
11. In your opinion, has COVID-19 permanently changed something in supply chain risk management?

12. What do you see as future threats to the company's supply chain risk management?
13. What do you think supply chain risk management will look like in the future?
    Will it change from the current situation?