LAPPEENRANTA-LAHTI UNIVERSITY OF TECHNOLOGY LUT

School of Business and Management

Supply Management

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DESIGNING RESILIENT SUPPLY CHAIN AND ENTERING NEW MARKETS

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Tekijä:	Tia Laurikainen
Otsikko:	Kestävän toimitusketjun suunnittelu ja uusille markkinoille meno
Tiedekunta:	Kauppatieteet / Hankintojen johtaminen
Vuosi:	2021
Pro gradu -tutkielma:	Lappeenrannan-Lahden teknillinen yliopisto LUT
Tarkastaja:	Jukka Hallikas
Avainsanat:	toimitusketjun resilienssi, toimitusketjun riskien hallinta, toimitusketjun kehittäminen, toimittajan suorituskyky, toimitusketjun häiriöt

95 sivua, 8 kuviota, 2 taulukkoa, 2 liitettä

Tämä tutkielma tehtiin tapausyritykselle valmistelemaan tuotekonseptin käyttöönottoa uusille markkinoille. Tutkimuksen aihe sai alkunsa uuden tuotesarjan lanseeraamisesta uudelle markkina-alueelle. Tutkielman tavoitteena on kartoittaa toimitusketjun nykyistä tilaa ja antaa toimitusketjun suunnitteluun näkökulmia, joilla lisätä toimitusketjun sietokykyä. Tavoitteena on tarjota viitekehys toimitusketjun sietokyvyn kehittämiseen kilpailuedun luomiseksi sekä nykyisillä, että uusilla markkinoilla.

Tutkimus tehtiin kvalitatiivisella tutkimusmenetelmällä. Tutkimuksen empiirinen osa suoritettiin kahdessa osassa. Ensimmäisessä osassa yrityksen toimitusketjua arvioitiin suorittamalla haavoittuvaisuuskartoitus riskiluokittelumallin avulla. Empirian toisessa osassa arvioitiin toimittajan suorituskykyä vallitsevilla markkinoilla hyödyntämällä puolistrukturoitua kyselylomaketta. Empiirisen osan avulla kartoitetaan yrityksen toimitusketjun nykyiset haavoittuvaisuusalueet sekä muut mahdolliset häiriötekijät. Lisäksi empiirisen tutkimuksen toisen osan avulla löydetään toimittajan suorituskyvyn keskeiset tekijät, jotka voivat vaikuttaa asiakastyytyväisyyteen.

Tämän tutkielman lopputulokset auttoivat hahmottamaan toimitusketjun haavoittuvuuksien nykytilaa sekä uusille markkinoille suunnatessa huomioonotettavia tekijöitä. Tulokset osoittivat, että toimitusketjuun on tärkeää luoda erilaisia ominaisuuksia, jotka parantavat toimitusketjun reagointikykyä ja mukautumista uusiin tilanteisiin markkinoilla. Nämä ominaisuudet mahdollistavat niin toimitusketjun häiriöistä selviytymisen, kuin tarjoavat arvokkaan kilpailuedun lähteen. Tulokset viittasivat myös siihen, että toimitusketjun sietokykyä parantavien ominaisuuksien tulee olla tasapainossa ja vastata yrityksen omia heikkousalueita. Täten on suositeltavaa kehittää yrityskohtaiset toimitusketjun sietokykyä parantavat omaisuudet toteuttamalla se osana yrityksen strategiaa.

Abstract

Author:	Tia Laurikainen
Title:	Designing resilient supply chain and entering new markets
Degree program:	Business Administration / Supply Management
Publication year:	2021
Supervisor:	Jukka Hallikas
Keywords:	Supply chain resilience, supply chain vulnerability assessment, disruptions, supply chain risk management, supplier performance

95 pages, 8 figures, 2 tables, 2 appendices

This Master's Thesis was conducted for a case company for preparing an introduction of concept of products to new markets. The topic of this research arose from the evaluation of launching a new product series in new market area. Therefore, the objective of the study is to examine currents state of supply chain and provide guidance of managerial aspects of supply chain design which increases the level of supply chain resilience. The aim is to provide an approach for developing supply chain resilience to create competitive advantage in both current and new markets.

The research was conducted by means of qualitative research method. Empirical part of the study was carried out in two parts. In the first part case company's current state of supply chain was assessed by conducting a vulnerability assessment. This assessment was done by using a risk classification model. The second part evaluated supplier performance on prevailing markets by semi-structured questionnaire. The empirical part provided information of current vulnerability areas and potential sources of disruptions for the case company. Furthermore, it indicated the key factors of supplier performance which may affect to customer satisfaction.

As a result, this research facilitated the understanding of current state of supply chain vulnerabilities and indicated future directions while entering new markets. Results further concluded that it is important to create balanced resilience capabilities since resilience capabilities not only enable coping with uncertainty but also provide a valuable source of competitive advantage. Therefore, it is recommended to develop company specific resilience capabilities into supply chain by implementing it as a part of strategy.

Acknowledgements

I want to thank especially my family and friends who have been an amazing support during the process of writing this Thesis.

Also, I would like to give a special thanks to the representatives of the case company who have provided the opportunity to conduct this research.

Tia Laurikainen

Helsinki 23.6.2021

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1 INTRODUCTION

According to research, creating resilience into supply chain enables companies to both diminish vulnerability and develop competitive advantage (Hamel & Välikangas 2003; Pettit, Fiksel & Croxton 2010; Sheffi 2008; Tang 2006a; Peck 2005; Wagner & Bode 2006). This can be achieved by developing supply chain strategies which enhance the level of supply chain resilience and recovery capabilities. Even improved state of supply chain performance can be achieved with resilience after disruptions. (Jüttner & Maklan 2011) There are strong evidence that improving the level of supply chain resilience can lead to improved competitive advantage, but why creating supply chain resilience is not the top priority for firms then?

According to prevailing literature the reasons behind this is, that there is wide interest among companies to gain competitive advantage through cost efficient supply chain management strategies (Gereffi, Humphrey & Sturgeon 2005; Gunasekaran, Subramanian & Rahman 2015). Nowadays supply chain executives strive to reduce costs and assets through implementing various supply chain initiatives such as outsourcing (Tang 2006b) and different strategies such as lean to increase revenue (Tang 2006a). However, these work the best at a stable environment. Research shows that currently most supply chains are developed upon an assumption of stability. Therefore, firms now suffer from their self-caused inflexibility (Christopher & Holweg 2011). While these developments in supply strategies have improved supply chain performance considering cost reduction, these have contributed to increased supply chain vulnerability (Hendricks & Singhal 2005).

Nevertheless, there has been a major change in the business environment which results increased complexity across the industries (Christopher & Holweg 2011). Certain main chances such as more global competition and greater scale of product diversity has resulted that nowadays supply chains are longer and increasingly complex (Sheffi & Rice 2005).The exposure for multiple types of disruptions triggered by fluctuating rates of economic cycles, consumer demands, and different disasters have also contributed to increased level of supply chain vulnerability (Skipper & Hanna 2009, Tang 2006b; Tang 2006a). Disruptions in the flows of materials, information and resources are nowadays part of these networks. Therefore,

uncertainty has increased considerably in supply chains. (Bode, Wagner, Petersen & Ellram 2011)

Also, it has been shown that this volatility and turbulence in business environment is going to continue being a prominent feature of the supply chain in the future as well. This has significant implications for designing supply chains. Especially increased volatility results that current state of supply chains should be re-evaluated. (Christopher & Holweg 2011) Overcoming and minimizing supply chains' vulnerability recalls the adaptation of different strategies in supply chains. These have driven various scholars to research the potential ways to improve supply chain resilience by realizing the significance of supply chain risk or vulnerability factors. (Gunasekaran, Subramanian & Rahman 2015)

Therefore, it is vital to identify the increase in challenges and to evaluate the consequences of increased uncertainties (Harland, Knight, Lamming & Walker 2005). In today's competitive business environment, the management of an extremely interconnected supply chain is a continuously rising challenge. There is an expanding interest in supply chain resilience among research as a critical element of business continuity and competitive advantage. Since competitive advantage is only temporary, it is vital to create supply chains that are adaptable to both turbulence of external demand fluctuations and factors of supply-side. (Christopher & Holweg 2011) Furthermore, unlikely events which still occur, make firms conscious of how little control they actually have over various of the risks they are faced with. A good example of this is the pandemic of COVID-19. Yet, some enterprises seem to be able to cope with the hazardous occurrences more successfully than others. This clear capability of some supply chains to recover from unavoidable risky events more successfully than others, has recently started a discussion about supply chain resilience (SCRES). (Jüttner & Maklan 2011)

Even though rising requirements for organizations to build comprehensive risk management processes, such as building resilience, supply chain management literature offers little help or guidance in practice (Hale, Moberg & Christopher 2005). The topicality paired with little practical help inspired me to conduct this research. The motivation is to fill the research gap in a way that results the understanding of resilience in supply chains and provide tools for companies to develop resilience capabilities to supply chain.

1.1 Objectives & research questions

The aim of this study is to examine characteristics of resilient supply chain and create a framework for building resilience in order to prepare an introduction of concept to new markets for a case company. The enterprise requested anonymity due to commercial secrets and confidentiality obligations, so it will be referred to as the case company in this thesis. The case company is a subsidiary for an enterprise which has the concept already operating in current target markets. Therefore, objective is to provide a comprehensive evaluation of the previous literature of supply chain resilience and furthermore to reflect the outcomes for future guidance for the case company when entering new markets with the concept.

Additionally, the purpose of empirical part is to firstly assess the case company's status of supply chain, in order to detect current vulnerability areas. Secondly, the aim is to evaluate case company's parent company's level of supplier performance in prevailing markets to provide guidance for the market entry. The main research question and sub-questions are presented and discussed below.

Main research question

◊ *How to design a resilient supply chain when entering new markets?*

Sub-questions

◊ *What are the main features of a resilient supply chain?*
◊ *How to develop resilience into supply chains?*
◊ *What are the main vulnerability areas which case company is facing currently?*
◊ *What are the existing challenges with prevailing markets by customers' perspective?*

The main research question is approached by four sub-questions. The first sub-question examines and defines the most important characteristics of a resilient supply chain. This question provides insights to earlier research and provides theoretical aspect of a resilient enterprise. The aim of the second sub-question is to assess how resilience can be designed

into a supply chain, to provide a practical framework of principles which improve the level of supply chain resilience. Objective of the third sub-questions is to identify the main areas which may cause vulnerability for the case company currently. Also, the aim of this sub-question is to conduct a classification of disruptive events and prepare the case company for these challenges. Fourth sub-question analyzes the current customer experiences of the supplier performance in present markets. The aim is to recognize existing challenges with the concept in prevailing markets, in order to prepare entering new markets.

1.2 Research methodology

This research is conducted by qualitative research. This enables holistic assessment of a case study. Case is an individual study and data is interpreted taken the unique characteristics into account. This method highlights the point of view of the case company. (Hirsjärvi, Remes & Sajavaara 1997, 155) Theoretical part of this study is based on secondary data from earlier literature. Empirical part is conducted by using a case study.

Case study was chosen since it enables versatile examination of current state of a case company. It is used in order to maximize the understanding of a specific case and there is no aspiration to generalization of the information gained from the study. One of the most beneficial outcomes of the case study is that it provides a descriptive data which can be used to formulate suggestions. The main objective of conducting this case study is to offer beneficial information for the case organization and since case studies are seen as a step towards actions, the case company is able to use the outcomes of the research in practice also. (Metsämuuronen 2005, 205-207) The emphasis in this thesis is to concentrate analyze the current state of case company's supply chain vulnerability and customer experiences. Also, estimation of the development of the supply chain resilience and supplier performance is provided in order to create success in new target markets. Case company is not named and the field where it operates stays unspecified.

First part of empirical study is conducted by using semi structured theme interview by applying a risk assessment model. This way assessment of disruptions can be conducted in a way that enables a case company's representative to explain by own words the questions asked. This risk assessment sheet can be found in the appendices. This is the most suitable since there is the need to classify disruptions of the case company. This interview style was

chosen since it gives clear structure but enables to continue discussion about the topics and deliver a holistic point of view.

Second part of empirical study is conducted by applying a theme-based customer satisfaction questionnaire in a semi structured way. The customers are given the opportunity to respond to beforehand designed questions on a provided scale. Questions are divided in separate themes. In addition, open questions are given to enable customers to further explain their experiences with their own words. These survey questions are provided in the appendices.

Tough, case study enables the holistic examination of a specific organization this research is based on interviews. This means that reliability of the study is dependent of the subjective interpretation and it should be considered as such. Also, the reliability of the risk assessment sheet is heavily dependent subjective assessment. The validity of used risk assessment sheet needs to be considered as it only takes into consideration the disruptions which need further actions and minor uncertainties are not included in the empirical analysis. However, this assessment covers the most relevant points of conducting this study and is proficient.

1.3 Theoretical framework

Key concepts of this research are supply chain resilience and vulnerability and these have the linkage to the management of the contextual disruptions. Conceptually supply chain resilience and vulnerability are part of the risk management framework. Figure 1 adapted after Jüttner and Maklan (2011) describes linkages between concepts. By managing supply chain risk with creating supply chain resilience there is an aim to reduce the effect of potential risks and increase the knowledge. With developing increased level of supply chain resilience and with the help of management controls, there is the objective to reduce supply chain vulnerability which is posed by external forces of change. (Jüttner & Maklan 2011; Pettit et al. 2010)

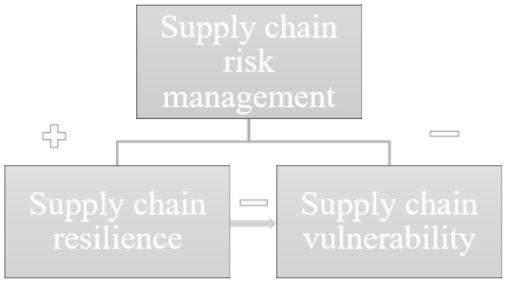

Figure 1. Linkages between concepts of SCRES, SCV and SCRM. (adapted after Jüttner & Maklan 2011)

Research problem considers the design of a resilient supply chain so, it is directly linked to the area of strategic management and supply chain strategy. Theoretical part of the study is based on earlier literature about resilience in supply chains and strategic management. Designing supply chain strategy which is taking resilience perspective into account is also a way to develop competitive advantage, so strategic management provides insights how building resilience can provide a framework to enhance business competitiveness. (Hamel & Välikangas 2003)

The theoretical framework behind this thesis is based on Dynamic capability theory. Dynamic capability theory is based on Resource-Based View (RBV) (Wernerfelt 1984). However, dynamic capability theory focuses in firm's unique capabilities and resources which are seen as a source of competence (Teece, Pisano & Shuen 1997; Wernerfelt 1984). The literature has divided dynamic capabilities and operational capabilities in firms (Teece 2007; Winter 2003). Dynamic capabilities include higher-level activities which facilitate conversion of company's ordinary operational activities towards more significant activities that offer greater rewards (Teece 2014). This framework emphasizes organizational and strategic managerial competences which are assessed to maintain competitive advantage by adjusting to changing business environment. Teece (2007) defines dynamic capabilities as abilities which enable companies to continuously develop, utilize and protect intangible assets. These dynamic capabilities provide sustainable advantage in the long term for enterprises, since they provide new resources which are hard to replicate. (Teece et al. 1997; Teece, 2007)

This framework is based on the utilization of firm's existing competences in order to address increasingly changing business environment. Furthermore, dynamic capabilities framework emphasizes the adaptation and reconfiguring internal and external capabilities to be able to respond to rapidly changing environment. (Teece et al. 1997) Therefore, dynamic capabilities framework offers a suitable base for this thesis to build analysis on. It is relevant to analyze the current state of supply vulnerability, so that adaptation and reconfiguring would be possible. Also, learning from customer experiences enables to utilize this knowledge in order to meet the market expectations and gain competitive advantage.

1.4 Structure of the study

This study consists of theoretical and empirical parts and there is total of seven chapters. The first chapter starts with the introduction of this study and provides objectives, research

questions and research methodology. Also, theoretical framework and key concepts are represented. The next three chapters creates the theoretical part of the study. The emphasis is in creating holistic view to studied themes. These chapters function as a foundation for empirical parts. After theoretical part, there is an empirical part which begins in the fifth chapter. The empirical study has been divided into two separate parts. First one, chapter five classifies the empirical findings of vulnerability mapping. The second part, chapter six analyzes the results of supplier performance. After this, chapter seven concludes the results and main findings. Discussion is provided on the reflection of on how the findings are positioned relative to previous research. Lastly, managerial implications are specified for future directions by providing suggestions. Detailed limitations are also provided at the end of the thesis.

1.5 Key concepts

Supply chain resilience (SCRes)

The term resilience is used in many distinct fields so there exists numerous definitions suggested for resilience, each slightly different due to the context. Though, the concept of resilience is commonly associated closely with the ability and capability to return to a steady state following a disruption. (Bhamra, Dani & Burnard 2011) Resistance of a supply chain is generally perceived as an ability which enables a company to get ready for, respond to, and recover successfully from disruptions (Scholten, Sharkey Scott & Fynes 2014). Resilience is connected equally to the individual and organizational reactions to instability and discontinuities (Bhamra et al. 2011). Likewise, Fiksel (2006) defines nature of resilient systems as the ability to survive, adjust and grow when encountering both uncertainty and unexpected disruptions. Furthermore, the organizational viewpoint underlines essential qualities of resilience such as adaptability, capacity to retain functions, recovery, and flexibility. (Ponomarov & Holcomb 2009) In other words, it is a proactive approach to managing supply chain risks. Implementing resilience in the supply chain systems enables supply chains to cope with unanticipated disruptions and develop competitive advantage. (Pettit et al. 2010)

Supply chain vulnerability (SCV)

Supply chain vulnerability (SCV) describes the sensitivity of the supply chain to different disruptions. This metric combines the probability of occurrence and the consequences of disruptions. (Svensson 2000, Christopher & Peck 2004) In other words, it reveals exposure to risks in supply chains. This is generally used in conjunction with supply chain risk concepts. (Wagner & Bode 2006) Since supply chains are at risk, they are also vulnerable and therefore likely to be damaged or lost (Christopher & Peck 2004). When SCV is addressed as the exposure of the supply chain to risks, SCV becomes a feature of any supply chain structure. SCV is an underlying state which only becomes visible if a disruptive event appears. Supply chain vulnerability prevails always in a certain degree in supply chains, regardless if it is managed or not. (Peck 2006) The vulnerability level to a particular risk differs significantly from company to company (Sheffi & Rice 2005).

Disruptions

A supply chain disruption is unintentional and exceptional event that causes the occurrence of risk (Wagner & Bode 2006). Supply chain disruptions can occur from many sources. There are major external sources that can cause natural disasters. Also, companies have potential internal sources of disruptions such as the loss of a critical supplier. Usually these events happen quickly and without warning and have potential consequences to the profitability of a company. (Ponomarov & Holcomb 2009) According to Sheffi (2008) all disruptions can be tracked to numerous generic causes and classifies them to four segments: random events, accidents, negligence, and intentional disruptions. According to Sheffi and Rice (2005) there is a typical profile of disruptions profile in terms of its effect on firm performance. They characterize eight phases of disruption which describe the nature of disruptions and dynamics of the firm's response to it.

2 SUPPLY CHAIN RESILIENCE

Acknowledgement that some companies recover from unexpected events better than others has evoked increasing attention of the framework of Supply Chain Resilience (SCRes) (Scholten et al. 2019). The combination of unstable business environment and increasingly sensitive supply chains have risen concerns widely among supply chain decision-makers. Awareness of the lack of preparedness in many supply chains has raised. Consequently, several enterprises have begun to view supply chain disruptions more critically and to reconsider their supply chain strategy and design. Yet, the competence to recover quickly from uncertainties has become also a central topic for practitioners and academics. (Wagner & Bode 2008)

The cohesive theory of resilience is still widely unexplored area of research and under development (Christopher & Peck 2004) since present definitions of resilience are often contradictory and inconsistent. Numerous gaps exist in resilient supply chain research. (Ponomarov & Holcomb 2009) In addition, there is literature in the field of supply chain management (SCM) of supply resilience but this theory is lacking guidance on the implementation of the model of supply chain resilience. However, government agencies are providing comprehensive practical guidance on disasters and inherent disruptions management. (Scholten et al. 2014) Also, the field of SCRM is well explored, and research provides a wide variety of empirical studies of different views or states of supply chain risk management (Jüttner & Maklan 2011).

The term resilience is used in many distinct fields so there exists numerous definitions suggested for resilience, each slightly different due to the context. Tough, the concept of resilience is still commonly associated closely with the ability and capability to return to a steady state following a disruption. (Bhamra et al. 2011) Christopher & Peck (2004) note that concepts of resilience and robustness have been used as synonyms. However, these concepts can indicate different implications in the context of supply chains. To clarify, meaning of "robust" emphasizes strong and durable in physique or construction. While robustness built in a process may be desirable, it does not itself compare to a resilient supply chain. Fiksel (2006) defines nature of resilient systems as the ability to survive, adjust and grow when encountering both uncertainty and unexpected disruptions. Mainly literature has described and highlighted resilience as a way to recover from disturbances. Supply chain resistance can

be seen as an ability that enables a company to get ready for, respond to, and recover successfully from disruptions. (Scholten et al. 2014) Resilience is connected equally to the individual and organizational reactions to instability and discontinuities (Bhamra et al. 2011). Moreover, most definitions have flexibility and adaptive capabilities as the key capabilities of resilience (Peck 2005).

Building resilience is seen as a proactive approach to managing supply chain risks. Implementing resilience in the supply chain systems enables to cope with unanticipated disruptions and develop competitive advantage. This is a great advantage compared with traditional risk assessment approaches which cannot manage unforeseeable events. (Pettit et al. 2010) Resilience capabilities seem have the ability to cope with uncertainty from different sources simultaneously (Jüttner & Maklan 2011). So, creating resilience has special relevance for more complex systems where unforeseeable events occur (Aven 2017). While SCRM emphases the identification and management of risks aiming to avoid sources of uncertainty (Jüttner, Peck & Christopher 2003), SCRES on the other hand, highlights the assumption that not all risk events can be prevented. It strives for developing the adaptive capability to prepare for unexpected events. (Jüttner & Maklan 2011) The concept also formulates a response to disruptions and a way to recover from them (Ponomarov & Holcomb 2009). Supply chain resilience and vulnerability are concepts which consider more about proactive risk responses instead of preventive risk mitigation processes (Tang & Nurmaya 2011).

To sum up, the organizational viewpoint underlines essential qualities of resilience such as adaptability, capacity to retain functions, recovery, and flexibility. So, next sub chapters provide definitions adopted by Ponomarov & Holcomb (2009) to analyze these concepts of resilience further.

2.1 Capability to retain functions

A main property of an ecosystem's resilience is the ability to preserve and maintain equal level of control over structure and function when a disruption happens. This same topic is found in the organizational viewpoint also. In this point of view resilience is the capability to sustain desirable functions and outcomes during pressure. (Ponomarov & Holcomb 2009) Also, Fiksel (2003) provides support with the definition of resilience being the function of a system to tolerate disturbances and simultaneously retain its structure and functions. According to Carpenter, Walker, Anderies, and Abel (2001) capability to retain operational

capabilities is one of the primary properties of resilience. This property reflects the amount of change that a process can tolerate while retaining the same controls and mechanisms on structure. However, while a strong system is able to maintain undamaged structure, a resilient system can also adapt simultaneously to new circumstances (Briano, Caballini & Revetria 2009).

Therefore, resilience capabilities extend beyond supporting a company to sustain operations after a disruption. When a company has resilience built in, it can adapt to unexpected situations and respond more quickly than competitors. (Briano et al. 2009) Even in situations when some disruption has effects on competitors equally, resilient companies can gain competitive advantage by being able to sustain their operations and responding accordingly to new positions in the market. This enables the opportunity to profit from on opportunities which competitors cannot. Therefore, companies can compete on their resilience competencies. (Rice & Canioato 2003)

2.2 Flexibility

Many scholars agree that flexibility is the main characteristic of resilient operations. Carpenter et al. (2001) has listed three primary properties of resilience and flexibility is suggested as one of them. They have defined flexibility as the extent to which the function is able to coordinate itself effectively and without force from external factors. (Carpenter et al. 2001) Research has some overlapping definitions for flexibility. Resilience involves traits of agility and velocity which is referred also as the flexibility and ability to adapt speedily (Ponomarov and Holcomb 2009).

Christopher and Peck (2004) defines resilience as “the ability of a system to return to its original state or move to a new, more desirable state after being disturbed”. Flexibility is therefore an inherent conception. The ability to return to original state after disruptive event captures the element of flexibility in the definition, since the system is able to restore its original state (Peck 2005). Respond and recover at the same level after the disruptive event has been commonly used feature across all the viewpoints analyzed containing social, economics, organizational, ecological, psychological, and emergency management. (Ponomarov & Holcomb 2009) Fiksel (2006) defines nature of resilient systems as the ability to survive, adjust and grow when encountering both uncertainty and unexpected disruptions. Also, Sheffi (2008) defines resilience as the capability to bounce back from significant

disruptions. However, existing literature of supply chain flexibility has broadly a limited definition since it defines flexibility as a reactive way to manage with uncertainty (Stevenson & Spring 2007).

According to research conducted by Brusset & Teller (2017) capabilities of flexibility effects positively to level of the resilience in a supply chain. Flexibility also improves the competitive position of a firm since it correlates positively to the responsiveness of a supply chain, fast-responding companies get the advantages compared to slow responders (Sheffi & Rice 2005). Nevertheless, resilience entails a level of flexibility and ability and it is much more than just sustaining and recovering from challenges. Flexibility enables to adjust to both positive and negative impacts of the environment. (Ponomarov & Holcomb 2009) Consequently, it is the ability to confront, resolve and utilize possible unexpected events (Jüttner & Maklan 2011). Flexibility also facilitates coordination processes and supports organizations to deal with high levels of uncertainties arising from environment and operations (Manuj and Mentzer 2008). In other words, flexibility is also seen as an adaptive capability of an organization. Many scholars have identified that resilience includes having capabilities of adaptive capacity. Research also shows that adaptive capacity is a vital element of resilient ecosystems. (Bhamra et al. 2011; Carpenter et al. 2001; Ponomarov & Holcomb 2009)

Element of adaptive capability indicates the response to a disruption and reflects a learning aspect (Carpenter et al. 2001). Staber and Sydow (2002) suggests that adaptive capabilities should be viewed as dynamic processes of continuous learning and adjustment. Furthermore, this allows to learn from the disruptive events and adapt by reacting in a suitable way (Carpenter et al. 2001). Additionally, this signifies also that the desired situation may be different from the original (Christopher & Peck 2004). Adaptive capacity allows firms to recompose fast in changing environment instead of simply identifying demands and then utilize the obtainable resources (Staber & Sydow 2002).

3 SUPPLY CHAIN VULNERABILITY

Supply chain vulnerability (SCV) has gained significant attention by practitioners as well as academics in recent years (Bhamra et al. 2011). SCV and supply chain resilience are (SCRES) closely related concepts since the main target of SCRES is reducing vulnerability of a supply

chain (Jüttner & Maklan 2011). Moreover, it is important to consider framework for defining vulnerability and prioritizing risks, when setting a target to build resilience in companies (Sheffi 2008). Yet, vulnerability is not considered as the opposite of resilience, since vulnerability refers to structural alterations and changes in stability. Resilience on the other hand, is an inherent function of a firm, which is not involving exposure to disruptions. (Gallopín 2006)

Academics have examined SCV in numerous ways. Consequently, the concept of vulnerability can be defined in several different ways. Most used definitions acknowledge that SCV is an elusive model due to its determinants. Supply chain design variables and environment in which the supply chain is operating determine the level of supply chain vulnerability. (Wagner & Neshat 2012) However, although the concept of vulnerability lacks a clear definition, in literature SCV is described mainly as the sensitivity of the supply and combines the probability and the consequences of disruptions (Svensson 2000; Christopher & Peck 2004). Therefore, it illustrates also exposure to risks in supply chains (Wagner & Bode 2006). When SCV is addressed as the exposure of the supply chain to risks, SCV becomes a feature of any supply chain structure. Vulnerability only becomes visible if a disruptive event appears. (Briano et al. 2009) Sheffi (2008) defines vulnerability as the combination of probability of a disruption to occur and the resilience of the firm to such disruption. Likewise, Jüttner et al. (2003) define SCV as exposure to different sources and risk drivers which overshadow risk mitigating strategies. Therefore, causing harmful consequences to supply chain. Effect of a supply chain disruption indicates the degree of SCV, in other words the more SCV a supply chain has, the more probable a disruptive event is, or the event has more severe impacts. (Jüttner & Maklan 2011)

Christopher and Peck (2004) uses risk in line with supply chain vulnerability. Since supply chains are at risk, they are also vulnerable and therefore likely to be damaged or lost. All partners within the supply chain can be affected as result of increased organizational integration and lowered inventory buffers. Consequently, the company's vulnerability to external events rises. (Neureuther & Kenyon 2009) Only one firm failing in a supply chain can cause severe harm to other firms as well (Bhamra et al. 2011). Likewise, it is relevant to notice that company’s vulnerability rises simultaneously when the level of dependency on its supply network and external resources rises (Lintukangas, Hallikas & Kähkönen 2015). Even the size of a company does not define that a company could withstand these challenges, it is

crucial that enough effort is concentrated into making any organization size robust and resilient enough to conquer disruptive events (Bhamra et al. 2011).

Wagner and Neshat (2012) suggests that SCV is a result of supply chain vulnerability characteristics. These characteristics have effect to both the likelihood of events and severity of supply chain disruptions. According to Pettit et al. (2010) there are several vulnerability factors that contribute to a company's state of vulnerability. These are divided to turbulence, deliberate threats, external pressures, resource limits, sensitivity, connectivity and supplier and customer related disruptions. Table 1 provides a definition of these factors and sub-factors to indicate potential causes for vulnerability.

Vulnerability factor	**Definition**	**Sub-factors**
Turbulence	Environment characterized by frequent changes in external factors which cannot be controlled	natural disasters, unpredictability of demand, pandemic, fluctuation in currencies and prices
Supplier/customer disruptions	Susceptibility of suppliers and customers to external forces or disruptions	supplier reliability, customer disruptions
External pressures	Influences, not specifically targeting firm, that create business constraints	competitive innovation, social change, corporate responsibility
Resource limits	Constraints on output based on availability if the factors of production	supplier, distribution capacity, availability of raw material, human resources
Sensitivity	Importance of carefully controlled conditions for product and process integrity	complexity, reliability of equipment, visibility to stakeholders, concertation of capacity
Connectivity	Degree of interdependence and reliance on outside entities	scale of network, degree of outsourcing, import and export channels
Deliberate threats	Intentional attacks aimed at disrupting operations	theft, labor disagreements, terrorism

Table 1. Vulnerability factors (Pettit et al. 2010)

According to Gallopín (2006) vulnerability constitutes three main factors. These are sensitivity, response capacity and exposure. Earlier literature indicates that sensitivity has the same properties that are linked to resilience or to coping capacity. Capacity to response is commonly defines as the capacity of a firm to adjust accordingly to a disturbance, control potential damage and utilize opportunities. Exposure refers to the degree, extent or time in which the firm is coping with the disruption. (Gallopín 2006) According to research, smaller companies are less exposed to supply chain risks and vice versa, the larger the company the more exposed it is to vulnerabilities (Wagner & Neshat 2012). Also, research indicates that the more complex logistical structure a supply chain has, the more vulnerable supply chain is.

This is the result of increased possibilities to have logistical delays. (Chaudhuri, Mohanty & Singh 2013)

3.1 Supply chain vulnerability assessment

Many scholars of the field of SCM point out that nowadays it is more important than ever that supply chain managers take the time to manage supply chain risk and vulnerability. This way costly disruptions can be avoided and their negative effects for the company. Managers benefit greatly of the capability to evaluate and quantify the vulnerability of their supply chain. This helps to recognize the risk exposure of supply chains and further identify the vulnerable areas in which risk management and mitigation strategies are essential. (Wagner & Neshat 2012) While traditional risk assessment frameworks are not able to forecast unforeseeable events (Gunasekaran et al. 2015), companies can optionally design systems with inherent resilience and reduce vulnerability by building resilience properties (Fiksel 2003). Thus, diminishing vulnerability means decreasing the probability of a disruption and improving resilience (Sheffi 2008).

There is no universally valid framework for the analysis of vulnerability which is reliable (Svensson 2000). Moreover, a vulnerability assessment is not comparable to a risk analysis since it measures different aspect of a supply chain. Assessment of vulnerability concentrates on the system survival capabilities and risk management to more impacts of an accidental event. The vulnerability examination has a broader range compared to the risk analysis framework. (Briano et al. 2009) A supply chain risk strategy which pursues to mitigate likelihood of a disruption does not have an impact on the level of SCRES, since it does not correlate to its increased ability to response to and recover from a disruption (Jüttner & Maklan 2011). However, risk analysis techniques can provide beneficial contributions to the resilience analysis. Considering risk can improve the assessment and management of resilience. (Aven 2017)

There are numerous modelling tools for vulnerability assessment, and they all have emphasis on different approaches. Therefore, when choosing a framework to assess vulnerability, it is priority to keep in mind the unique characteristic of the case and the objectives of the analysis. (Salmela, Toivonen & Scholliers 2010) Supply chain risk management methods are based on the identification of risks. Realistically, it is not possible to identify all possible risks, so the identification puts emphasis on the most substantial ones which impact on the supply chain.

(Hallikas & Vilko 2012) Especially, when intended to manage supply chain vulnerabilities proactively, it is essential to have empirically validated methods to support managers in computing and tracking vulnerabilities in supply chains. Companies need to know both the current level of vulnerability that exists in a supply chain and also the drivers of vulnerability. Then drivers of vulnerability can be modified, and a company is able to accomplish the level of supply chain vulnerability which matches the wanted level of tradeoff between risk and reward. (Wagner & Neshat 2012)

There are many scales which can be used to evaluate risks, for example, to standard ISO 28001. The most common one is a three-scale division of probability and consequence. (Salmela et al. 2010) Sheffi and Rice (2005) among many other researchers recommends categorizing potential disruptions as a function of their probability and consequences. Firms vulnerability assessment should consider events that may cause turbulence or challenges for the company. This assessment should evaluate the likelihood for the event to take place. Also, the analyze of the consequences of these events should be conducted. Since approach of vulnerability mapping is generally used in the research area of supply chain vulnerability, it is further analyzed and applied in the empirical part of this study. This framework is presented in Figure 2.

By using this framework, disruptions can be categorized according to their probability and consequences (Salmela et al. 2010). A company specific vulnerability map can be created by identifying threats and sources of potential challenges and placing them in the suitable quadrant of the vulnerability framework. Evaluation of supply chain vulnerabilities should consist a variety of supply chain functions. Existing literature recommends especially including the assessment of vulnerability logistics. If logistics score high in vulnerability assessment, logistics issues should be engaged actively in supply chain resilience planning and management. (Wagner & Neshat 2012) With the help of these maps, management can direct attention appropriately and prioritize planning (Sheffi & Rice 2005). As a result, framework provides categorization of low, moderate and high vulnerability areas. Vulnerability mapping is a useful tool for recognizing the most important areas which affect and bring vulnerabilities to the security or safety in the supply chain. (Salmela et al. 2010)

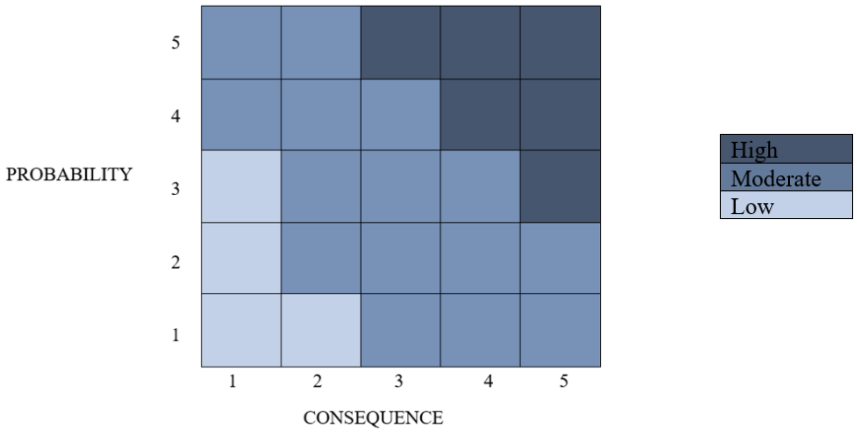

Figure 2. Prioritizing vulnerability areas (adapted after Sheffi & Rice 2005; Zsidisin & Ritchie 2009)

The areas which pose vulnerability for a company can then further analyzed (Salmela et al. 2010). It is vital to continuously update vulnerability maps as new uncertainties emerge. Not only familiar risk factors should be taken into account, but also the weaknesses of more complicated and sensitive global supply chains should be concerned. For example, comprehensive scenario planning can be used to complement vulnerability mapping in order to model the dynamics and outcomes of high-impact risks. (Sheffi & Rice 2005) Due to the increased collaboration and network environment, risks can transfer between the companies. This works both ways since interconnectivity may increase risks in some area of operations and decrease in another area. Therefore, it is vital to analyze company's own status. (Hallikas, Karvonen, Pulkkinen, Virolainen, Tuominen 2004) Also, Neureuther & Kenyon (2009) highlights the importance of assessing supplier's vulnerability before establishing supply chains and during the operations. The assessment should include three categories: financial, technological, and operational resulting an assessment of the potential failure probability of supply chain partners. This assists to take actions accordingly to the specific vulnerabilities. Although, companies are always dependent on the circumstances of each network, company, branch, and economical circumstances. Therefore, there is no generic and complete assessment which could be conducted. (Hallikas et al. 2004)

Further assessment and development of operations is needed when disruptive events score high both at probability and consequences. Although, risks which score with low possibility and severe consequences are tended to be tolerated (Jüttner & Maklan 2011), it is one category that requires planning and preparing response in a more systematic way (Sheffi & Rice 2005; Salmela et al. 2010). Furthermore, even if event has medium probability and high consequences, it necessitates further actions (Salmela et al. 2010). Events which have the

lowest levels of vulnerability are characterized as low-consequence and uncommon events. These events require only little preparation or action. (Sheffi & Rice 2005) When the disruptive event is common and has a high likelihood to happen but low consequences, these are part of daily operations management. Yet, when disruptions combine low probability and high effect it is necessary to plan and prepare response in a more systematic way. Companies are becoming gradually more disposed to high-impact/low-probability events. (Sheffi & Rice 2005) Furthermore, probability and consequences are the main functions of the framework which define the urgency of risk management control measures (Salmela et al. 2010). Also, when a disruption happens, it is important to determine fast what impacts it will have on the network containing the propagation path as well as the effect (Blackhurst, Rungtusanatham, Scheibe, Ambulkar 2018). The vulnerability to a particular risk differs significantly from company to company (Sheffi & Rice 2005). Considering the launch process and ensuring the desired objectives of the product launch, it is essential to recognize and understand the weak links in the supply chain (Chaudhuri et al. 2013).

However, determining supply chain vulnerability is challenging because of so-called drivers of vulnerability. This is because these drivers (e.g. globalization of the sourcing network and customer or supplier dependence) are not possible to observe or measure directly. Secondly, supply chain vulnerability is a multi-dimensional concept and there does not exist well-developed metrics for assessing the drivers on which vulnerability depends. (Wagner & Neshat 2012) Also, there are numerous uncertainties which make it challenging to monitor the supply chain during new product development process. These uncertainties can occur from multiple different reasons such as uniqueness of the product design, contracting with a new supplier and lack of knowledge about supplier's performance. Product development projects are commonly complex and involve several suppliers. Therefore, literature suggests that applied framework should be simple enough and carried in a group. This enables managers evaluate the vulnerability of systems and their suppliers in a real-life situation and develop mitigations plans accordingly. It is also suggested that suppliers should be involved in those mitigation plans in the overall product development plan. (Chaudhuri et al. 2013)

3.2 Disruptions

As discussed earlier, recently the level of uncertainty has risen radically due to interdependent trends (Sheffi & Rice 2005). As supply chains are becoming more and more complex, this

results more sensitive supply chains which are disposed to different types of disruptions (Skipper & Hanna 2009; Wagner & Bode, 2008). Especially trend of outsourcing practice in supply chain management has increased considerably the risk of disruptions. Outsourcing globally extends supply chains and therefore increases both complexity and reliance on outsourcing and partnering. (Hendricks & Singhal 2005) This increases the vulnerability of companies involved by exposing them to potential failures of other parties and to opportunistic behaviors (Neureuther & Kenyon 2009). Additionally, greater integration increases the level of dependency between firms in practice resulting exposure to larger scale of risks (Hallikas et al. 2004). As a result, breakdown of any element in supply chain may result the whole network to fail (Rice and Canioato 2003). Due to the nodes of the global supply network, disruptions in one part of the supply chain, can quickly move through the rest of the supply chain (Hendricks & Singhal 2005). It is vital to also assess network structure and notice that disruptions can occur due to the network environment by transferring according to supply network dependency links. Existence and criticality of suppliers may only therefore be noticed due to a supply chain disruption. (Yan, Choi, Kim & Yang 2015)

Ideally, modern supply chains allow goods to be manufactured and distributed in the right quantities, to the right locations, at the right time in a cost-efficient way (Christopher & Peck 2004). However, this is not the case when disruption happens, and company is therefore not capable to match demand and supply (Hendricks & Singhal 2005). A supply chain disruption is unintentional and exceptional event which causes the occurrence of risk (Wagner & Bode 2006). It is important to note that not only disasters, but also small uncertainties can cause challenges to firms (Bhamra et al. 2011). There is a need to cope also with more conventional disruptions such as supply variability and capacity restrictions (Sheffi & Rice 2005). Craighead et al. (2007) studied the factors affecting to the severity of supply chain disruptions and found out that supply chain complexity and node criticality are potential factors. Also, the supply chain density correlates positively to the severity of disruption.

As a result of disruptions, market share can be diminished, and sales lost. Also, these may cause increased costs due to premium and expedited logistics services. (Ponomarov & Holcomb 2009) Empirical evidence points out that supply chain disruptions can have severe consequences such as loss of profit and cause damage of market share (Tang & Nurmaya 2011). Therefore, supply chains should be created to include event readiness. Supply chains should deliver an effective response to disruptions and have the capability to recover to at

least their original state after a disruption. According to Ponomarov and Holcomb (2009) this is the core of supply chain resiliency. Also, Fiksel (2006) states that in the face of disruptions, there is a serious need for the knowledge of the dynamic and adaptive performance of complicated systems and especially their resilience.

On the other hand, Christopher and Holweg (2011) point out the importance of assessing business environment that a company is operating in. Uncertainties affecting to supply chain can come up from all sorts of areas, and these are not isolated incidents. These incidents such as earthquake or pandemic, fundamentally changes many key variables which define our business environment. Therefore, it is important that organizations understand the challenges concerning procurement in order to deal with different types of process and product complexities (Gunasekaran, Subramanian & Rahman 2015). Also, Fiksel (2003) emphasizes that especially when organization faces substantial disruptions or discontinuities which move the system away from its current state, the understanding of resilience is especially significant.

3.2.1 Sources of disruptions

Supply chain disruptions can occur from many sources. Literature has also categorized disruptions in a numerous different way with overlapping categorizations. Roughly, disruptions can be divided to external environmental and internal company related sources of disruptions. There are multiple major external sources which can cause natural disasters. Also, companies have several potential internal sources disruptions such as the loss of a critical supplier or complexity in product design. (Ponomarov & Holcomb 2009) There is also product and process design risk, which reflects the incapability to manage with changes, related with new product development stage (Tang & Nurmaya 2011). Since global supply chains are constituting from several distinct companies acting in a complex logistical arrangements, disintegration and specialization of operations have resulted that supply chains are vulnerable to both internal and external disturbances (Vilko & Hallikas 2012). Likewise, firms' decisions to perform activities in-house or sub-contracting will define the level of complexity and uncertainties in its supply chain (Ponomarov & Holcomb 2009).

Management is experiencing risk on several levels, but Sheffi and Rice (2005) states that primary reason for risks is coming from uncertainty in the demand for products. Demand forecasts are proven to cause major uncertainty and risks in production (Hallikas, Virolainen & Tuominen 2002). Furthermore, Hallikas et al. (2004) categorizes main uncertainties arising

from customer demand and customer deliveries. Due to economic trends or change in demand preferences, products' demand can fluctuate causing a mismatch of supply and demand. Also, Johnson (2001) points out that sources of vulnerability arise from especially product demand including seasonality challenges and volatility. Delivery uncertainties are related to company's capabilities to manage time, quality, costs and also duties for confidential information. In addition, markets and accordingly products are changing continuously. So, if a company aims to remain in the network, it has to adapt to these market changes. Thus, weaknesses in flexibility, development, and resources, pose possible sources for disruptions. (Hallikas et al. 2004)

Several categorizations of supply chain risks can be found in the literature. The applicability of these depend on the supply chain in question. (Vilko & Hallikas 2012) Considering supply chain disruptions, according to Sheffi (2008) all disruptions can be tracked to numerous generic causes and classifies them to four segments: random events, accidents, negligence, and intentional disruptions.

Firstly, random events consider the environmental circumstances such as floods and earthquakes. Insurance companies can estimate probability and establish insurance pools according to their frequency. (Sheffi 2008) Second category is accidents which are usually a consequence of numerous causes. Yet, a wide scale of literature on accident avoidance can be found. It is based on "near miss" analysis and the "safety pyramid" techniques. (Sheffi 2008) Also, the possibility of accidents can also be evaluated from industry data (Sheffi & Rice 2005).

Third category is based on cases caused of negligence. In these cases, non-compliance with guidelines or standards occurs. (Sheffi 2008) These conventional disruptions can be caused by supply variability, manufacturing yields, capacity constraints and parts quality problems (Sheffi & Rice 2005). Ponomarov and Holcomb (2009) remind that also as a result of the attempts to build a more cost-effective supply chain by outsourcing can cause disruptions. This supply chain-dependent environment can result a much more noticeable impact as it flows either upstream or downstream in the supply chain. This increases the vulnerability of companies involved by exposing them to potential failures of other parties and to opportunistic behaviors (Neureuther & Kenyon 2009). Also, not following regulations or not taking into account shifting public attitudes regarding corporate social responsibility can be a

source of disruptions (Sheffi 2008). Disruptions can therefore occur as a consequence of the emergence of new regulatory (Fiksel 2003).

Fourth category includes intentional disruptions which consider terrorist attacks but also industrial actions, such as industrial spying and sabotage. Intentional disruptions are result of an act of an opponent. (Sheffi 2008) For example, suppliers could turn to become competitors and therefore try to acquire firm's resources and knowledge (Gunasekaran et al. 2015). This is called "smart adversary" and it means that the opponent adapts when defensive actions are implemented (Sheffi 2008). As a consequence, disruptions can be result of the introduction of new technologies and market forces, or changes in the availability of resources (Fiksel 2003). The above examples demonstrate that any material, information or financial risk can create troubles in a supply chain and without preparation and protection, it takes time for the disturbed structure to recover. Intentional disruption's likelihood is more difficult to estimate since usually these events lack of historical data. Also, the probability is company specific and varies vastly depending on the company's decisions and actions. Probability and company's resilience to adaptive threats will change along with a company's actions. (Sheffi & Rice 2005)

Moreover, Pettit et al. (2010) lists seven factors that contribute potentially to supply chain disruptions. These are globalized supply chains, specialized factories, increased outsourcing, centralized distribution, reduced supplier base, increased volatility of demand and technological innovations. All in all, global sourcing is related to endless list of possible risks. Some of these disruptions like quality defects, high inventory levels and delays are manageable from an operational view. (Gunasekaran et al. 2015) Moreover, future requirements create an additional uncertainty for companies. Companies should be able to maintain and adjust knowledge and resources in order to be successful in the future (Hallikas et al. 2004).

3.2.2 Stages of disruptions

According to Sheffi and Rice (2005) there is a typical profile of disruptions in terms of its effect on firm performance, regardless how the performance is measured (sales, production level, profits, customer service etc). They characterize eight phases of disruption which describe the nature of disruptions and dynamics of the firm's response to it. This profile is described in Figure 3.

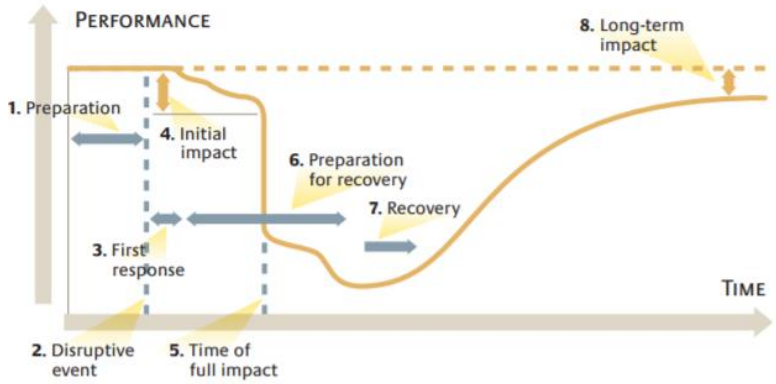

Figure 3. Eight phases of disruption (Sheffi & Rice 2005)

First phase is the preparation. Sometimes a company is able to forecast and predict a disruption to happen and to prepare to it. This how minimizing the impacts is possible. Warnings range from natural phenomena to expecting a labor strike to happen after labor negotiations. However, some cases may have only little, or no warning signs at all. (Sheffi & Rice 2005) Mainly, risks and uncertainty at a higher level are not every time easy to evaluate (Gunasekaran et al. 2015). Detection lead time indicates the time between recognizing that disruptive event will take place and its initial effect on the company. These detection lead times fluctuates much due to the type of disruption and the vigilance of the organization. (Sheffi 2015)

Second phase is the disruptive event itself. There are many sources of external environment risks. Disruptions can be linked to any unexpected and unplanned incident that influences the normal flow of goods. (Craighead, Blackhurst, Rungtusanatham & Handfield 2007) These include for example bankruptcy of a supplier, labor strikes, natural disasters, opportunity costs and so on (Sheffi & Rice 2005; Gunasekaran et al. 2015). Third phase describes the company's first response to the disruptive event. Regardless of the type of the disruption, first response is intended to control the situation, closing affected systems and prevent further damage. Fourth phase considers the initial effect. In some cases, the full effect of some disruptions is experienced instantly, but on the other hand, some disruptions can take time to have an impact to company. This depends on multiple factors such as the extent of the disruption, the existing redundancy, and the built-in resilience of the firm and its supply chain. After the initial effect, full effect takes place and the firm's performance usually drops suddenly. Recovery preparations begins in the sixth phase. Recovery phase is about getting back to normal operation levels. Last phase of disruptions is long-term effect. It normally

takes a longer period of time to recover from disruptions. Especially, if customer relationships are harmed, the effect can be particularly long-lasting and challenging to recover from. (Sheffi & Rice 2005) Companies have to create very appealing incentives in order to counter a damaged reputation. Fixing damaged reputation significantly increases customer acquisition costs. (Reichheld 2003)

4 DESIGNING RESILIENCE INTO SUPPLY CHAIN

Essence of resilience is embedded to the strategic design, companies which can generate strategic options and rearrange its resources faster than its competitors, have a significant advantage. This necessitates supply chain strategy change and a comprehensive assessment of strategy. (Hamel & Välikangas 2003) Therefore, creating resilience into a supply chain should be a strategic choice for companies (Sheffi & Rice 2005). Firms of any size can achieve the same level of resilience. According to research conducted by Brusset and Teller (2017) the firm size or economic sector does not determine the level of resilience.

Although, specific strategies which could potentially enhance the level of SCRES are remaining unidentified and firms have only little guidance of the most effective strategies (Blackhurst, Dunn & Craighead 2011). Also, original causes of disruptions, are not easy to fix (Hendricks & Singhal 2005). It is rather a great challenge for managers to improve resilience since prevailing literature is lacking some empirical evidence and proven theories about the way's organizations can achieve resilience. Thus, more research of the area is needed especially of the real cases of businesses. (Bhamra et al. 2011) Also, in the area of supply chain risks associated to new product development process is needing further research. Research concentrates on different applications of risk assessment methodologies; however, it does not give advice on establishing detailed strategies to mitigate those risks. (Chaudhuri et al. 2013) Therefore, improving supply chain resilience with strategic design is further examined.

Literature suggest that capabilities which improve the level of supply chain resilience, can be developed in multiple ways. Jüttner and Maklan (2011) suggests four resilience capabilities which decrease the impact of disruptive events: flexibility, velocity, visibility and collaboration. These capabilities seem to improve resilience by being able to address multiple

risks simultaneously. Fiksel (2003), also classifies four similar main system characteristics that provide the source of resilience. These are diversity, efficiency, adaptability and cohesion. Pettit et al. (2010) found 14 capabilities which correlate positively with incresed levels of SCRES. These are listed in the Table 2.

Resilience capabilites	
flexibility in sourcing	dispersion
flexibility in order fulfilment	collaboration
capacity	organization
adaptability	market position
efficiency	security
visibility	financial strenght
recovery	anticipation

Table 2. Resilience capabilites which correlate positively to supply chain resilience (Pettit et al. 2010)

In order to implement these resilience capabilities to company's supply chain, Christopher and Peck (2004) suggests four key principles for creating resilience into supply chain. These are Supply Chain Re-engineering, Supply Chain Collaboration, Agility, and Creating a Supply Chain Risk Management Culture. These principles were repetitively occurred in the resilience literature with similar characteristics and therefore chosen to this study; these main principles are further analyzed in the next sub-chapters. However, agility is referred as flexibility since, Christopher & Peck (2004) defines agility as an ability to respond fast to sudden changes in demand or supply, which is also used as one of flexibility's key characteristic by other researches (see Christopher & Holweg 2011; Ponomarov & Holcomb 2009; Sheffi 2008; Sheffi & Rice 2005) Also, often agility and flexibility are used as synonyms, but mostly the literature applies the concept of flexibility.

4.1 Supply chain re-engineering

Primarily, resilience should be designed into a supply chain. Research has proven that specific elements can enhance the level of resilience in supply chain, if they are incorporated. (Christopher & Peck 2004) Even though there is no universal method for building supply chain resilience, there is few suggestions to start with (Hamel & Välikangas 2003). Each

organization will have unique requirements to meet and therefore determining the suitable systems to cope with supply chain vulnerabilities and risk seems to be context-specific (Scholten et al. 2014). Also, Christopher & Holweg (2011) point out the importance of assessing company's business environment. Creating resiliency is a preferable trait in a supply chain but it also presents additional costs due to increased coordination cost (e.g. due to multiple sourcing) and slack resources. But since uncertainties affecting to supply chains can come up from all sorts of areas, uncertainty prevails in the whole supply chain network. In the era of uncertainty there is a need to reconsider how to operate and build supply chains which are adjustable to changes. Therefore, in order to adjust the different types of process and product related complexities, it is important that organizations understand the challenges concerning supply chain context (Gunasekaran, Subramanian & Rahman 2015).

Firms can design their structure externally in a numerous way, in order to reduce uncertainty and create an optimal structure for a supply chain. Firstly, suitable models and empirical research should be conducted to assess the state of current supply chain. (Ponomarov & Holcomb 2009) Typically supply chains which have structural flexibility capabilities have achieved this by several actions. Main actions include dual sourcing, asset sharing, flexible labor arrangements, rapid manufacture and outsourcing. (Christopher & Holweg 2011) Traditionally supply chains have been designed to optimize the level of customer service and the cost efficiency (Christopher & Peck 2004). Due to this, most firms are reducing their suppliers and developing deeper relationships with key suppliers. The trend is indicating that most companies will continue to reduce their suppliers and developing the relationships with only preferred suppliers (Trent & Monczka 2002). But since nowadays supply chains are more exposed to uncertainties, the previous design model should be questioned (Christopher & Peck 2004).

Each method for developing resilience into a supply chain, has different cost and service characteristics. This needs to be considered when designing resilience. (Rice & Canioato 2003) The trade-offs between efficiency, coordination costs, reliability, and risk of failure should be further assessed, so the supply chain remains competitive. Market environment, industry, and the firm's strategic objectives are key determinants in defining this balance. This assessment enables the design of a more competitive and risk-adverse strategies accordingly to a company's current situation in its business environment. (Neureuther & Kenyon 2009) Since it is impossible to fully prepare for all possible contingencies and spending vast sums

of money and energy preparing for an event which might not even occur, does not connote high adaptive capacity. As a result, it is difficult to define which structural properties make organizations adaptable and therefore, it is important to have a problem-solving ability. (Staber & Sydow 2002) This is very important in a rapidly changing business environment. Finding strategic solutions that will ensure the greatest level of adaptability is more relevant than cost-efficiency based strategies. (Christopher & Holweg 2011)

A common advice for managers is to review the structural assets of their firm and also networks capabilities and reflect these to developing a suitable incentive structure (Staber & Sydow 2002). Wagner and Bode (2006) emphasizes that companies would benefit from a better understanding of how supply chain design impacts to the exposure of risks. This would help managers to design their supply chain structure in a way that reflects readiness and improves supply chain design decision making. For example, mapping tools can help to recognize network characteristics such as bottlenecks which limit the operating capacity (Christopher & Peck 2004). This enables managers to recognize current potential capabilities in order to contribute building adaptive capacity. This kind of proper analysis of the structural properties, would at least increase managers' awareness of essential factors and relationships, even though optimal level of adaptive capacity cannot be determined nor managed. (Staber & Sydow 2002)

Consequently, research suggests that balanced resilience capabilities should be created in order to improve the level of supply chain resilience. More precisely it is about developing a portfolio of capabilities which matches to pattern of vulnerabilities. So, that only needed resilience capabilities should be created, since if the resilience capabilities are overly developed, it may cause eroded profitability. (Pettit et al. 2010) Also, Zsidisin and Ritchie (2009) point out that improved supply chain security level correlates to increased costs. Therefore, the positive effect of improved risk management decreases after a certain point of supply chain security has been achieved. Furthermore, due to the limited resources, there is need to evaluate the prior areas where to create resilience (Aven 2017).

Correspondingly, only when maintaining balance between capabilities and vulnerabilities, the best level of resilience will be achieved. Therefore, managerial capabilities need to be adjusted with the inherent vulnerabilities of the supply chain design and the business environment in which a firm operates. (Pettit et al. 2010) As a consequence it is vital to create supply chain management skills and expertise about the topic. Also, building an infrastructure which has

emphasis on improving responsiveness and reliability is suggested to take into consideration. (Hendricks & Singhal 2005)

4.1.1 supply chain design principles

The supply chain design has a vital role in determining how easily a supply chain can be re-configured and the level of flexibility it can achieve (Stevenson & Spring 2007). Traditionally supply chain decision making has put emphasis on the economies of scale. This is still valid point to take into account; however, this is best implied in a stable business environment. Therefore, it should not be dominant argument in determining supply chain decisions. (Christopher & Holweg 2011). According to Hamel and Välikangas (2003), while creating a resilient strategy, a future oriented mindset is vital. A common mistake is to invest current operations instead of future strategies. Adaptability to changes gives the flexibility to respond to new uncertainties (Fiksel 2003). Success nowadays requires the development of new concepts and the implementation of new organizational forms and business models (Teece 2007).

Thus, Hamel and Välikangas (2003) remind that strategic resilience is much more than responding to crisis and rebounding back from disruptions. The essence of resilience is continually anticipating and adapting to profound, secular trends since otherwise these can cause permanently harm to the business performance. It is then about the capacity to be ready to change whenever. Resilience requires the ability to develop plenty of new alternatives as compelling options to substitute outdated strategies. Primarily research highlights that the alternative production plans and creating more flexible and versatile plans amplify flexibility (Brusset & Teller 2017). Diversity ensures the existence of multiple forms and behaviors (Fiksel 2003). Therefore, supply chain strategies which keep multiple options open are important (Christopher & Peck 2004). These properties of supply chain design can be seen as SCRES enhancers. Blackhurst et al. (2011) points out the importance of having supply chain resilience enhancers. These capabilities can reduce the effect of a disruption and contribute to supply chain resiliency. Also, certain resilience capabilities are recommended to implement since these have been proven to support the creation of resilience. Previous research emphasizes two ways to get ready for responding disruptions; building redundancy into supply chain operations and increasing flexibility. (Sheffi 2008; Sheffi & Rice 2005)

Scholten et al. (2014) point out that building supply chain resilience capabilities also necessitates mitigation processes which reduce the vulnerability of the supply chain. These enable preventive solutions and performance of the essential processes during preparedness, response, and recovery stages. Mitigation capabilities are related to regular organizational processes which help to recover from disruptions and additionally assist to create awareness of disruptions across organizations (Hallikas et al. 2004). Research further suggests that companies need to implement a proactive supply chain risk management to prevent long-term negative impacts of disruptions (Wagner & Neshat 2012). The most important elements of proactive management are flexibility, efficiency and the capability to response quick enough (Gunasekaran, Subramanian & Rahman 2015).

Furthermore, it is recommended that supply chain design should be both resilient and secure accordingly to complex business environment. A supply network that is highly secure does not guarantee that it is resilient as well and vice versa. Some initiatives will offer the advantages of both supply network security and resilience, other contribute only one of them. (Rice & Canioato 2003) However, more research is needed to conduct about designing strategies that reduce complexity in supply chains (Ponomarov & Holcomb 2009). Since the supply chains are embedded to inter-organizational networks, creating a resilient network considers much more than the design and management of robust supply chain processes. There are many uncontrollable forces in the network environment, so it is important to accept that complexity and limited managerial control. (Peck 2005) Also, given the complexity of global supply chain operations it is difficult to find a study which represents a resilience framework in terms of complexities and proactive management strategies (Gunasekaran et al. 2015).

4.1.2 supply base strategy

Firstly, it is necessary to understand the network connected to the business (Christopher & Peck 2004). Supply chain design and development are linked to complexities arising from network of suppliers. The number of co-operating partners correlates highly with the supply chain structure and informational features (Ponomarov & Holcomb 2009). Therefore, it is important to have a broader view of the supply chain in order to properly identify potential risks (Vilko & Hallikas 2012). Optimal supply chain structure integrates all the activities with

supplier, customers and partners and consequently helps to overcome these complexities (Ponomarov & Holcomb 2009).

Supply chain re-engineering considers also the strategic options of supply base. When building resilience, it is necessary to apply a "just in case" perspective on the supply chain, this applies also for routine operations. In recent years, this principle has truly challenged some of the trends in supply chain management area. (Jüttner & Maklan 2011) Single-sourcing strategies may reduce costs considering purchase prices and the administrative costs of managing the supplier base. However, as a result of using single supplier, the vulnerability of supply chains is higher, and companies are more dependent on supplier capabilities. (Hendricks & Singhal 2005) A supply chain which has many suppliers and therefore more available capacity, is less vulnerable compared to the previous option (Chaudhuri et al. 2013). Therefore, research suggests that having multiple suppliers is more useful strategy to pursue, considering the aim of resilient capabilities. This allows to have alternative sources for key raw materials (Christopher & Holweg 2011). Also, uncertainty can be mitigated when single sources are used for several sites separately. Likewise, if there is a range of products, if single sourcing is used for a product, it is suggested that alternative source of supply is kept available. (Christopher & Peck 2004) Therefore, long term strategy should be paid special attention if cost-cutting strategies are implemented. The cheaper partner option can turn out to be costlier option because of infrastructure-related uncertainty. (Gunasekaran et al. 2015)

However, the number of suppliers is secondary when implementing flexibility capabilities. More important is the correct alignment of procurement strategy with the type of corporate-supplier relationship. When using a single supplier, a deep relationship and collaboration is necessary. On the other hand, some companies choose to have less dependency and have numerous suppliers, so the risk of losing critical capacity can be spread. (Sheffi & Rice 2005) Thus, assessment of suppliers is regarded as vital element of supply chain design and development. It is important to identify suitable suppliers based on appropriate criteria. (Ponomarov & Holcomb 2009) Research suggests that the criteria for selecting suppliers nowadays supply chain environment should contain flexibility, quality, responsiveness, cost, reliability, and knowledge management capacity (Gunasekaran et al. 2015). These concepts are closely linked to resilience capabilities. Thus, research suggests that the risk awareness of the supplier should be chosen as one of the key criteria for the selection of suppliers. Furthermore, pro-active strategy of supplier development can be implemented for main

suppliers in order to help them develop their supply chain risk management practices. (Christopher & Peck 2004)

For choosing suitable risk management actions relationships and linkages with suppliers are suggested to be investigated further (Hallikas & Lintukangas 2016). Yan et al. (2015) highlights the importance of assessing suppliers power relation in a network environment in order to analyze the importance of a supplier. It is important to recognize the existence of suppliers which are critical from a network perspective. These are usually multiple tiers away from the focal buying. Consequently, existence and criticality may only occur when some disruptions happen. Therefore, assessing the network structure and lower tier suppliers in order to recognize the links and potential criticality of suppliers is suggested. In addition, trust between partners has become a growing concern since increased complexity in the supply chain. Therefore, relationships should be regularly evaluated regarding future strategies and position. (Neureuther & Kenyon 2009) Especially during the product development stage it is necessary to recognize weak links in supply network. This helps to mitigate the impact of those vulnerabilities. (Chaudhuri et al. 2013) Also, it is suggested to have for a streamlined process for bringing new suppliers on board. This allow firms to find quickly new sources of needed goods in case of a disruption. (Christopher & Holweg 2011)

Resilience can also be enhanced by the planning of the supplier's locations. Having the combination of alternative production and site plans improves resilience. (Brusset & Teller 2017) When designing locations of suppliers, a globally dispersed portfolio has more likely a positive effect to supply chain resilience. Dispersing suppliers will enable a flexible response to a disruptive event since a company can utilize suppliers from other regions if only one region is affected by the disruptive event. (Jüttner & Maklan 2011)

4.2 Creating flexibility

According to many researchers, one of the most potential way to create resilience is to develop flexibility. It has been proven to provide the most potential a way to enhance competitive positioning, compared to other resilience measures (Brusset & Teller 2017; Rice & Canioato 2003; Sheffi 2008). As a result of extended supply chains, several challenges occur in supply chains such as dependency on limited number of suppliers and incapability to respond quickly to uncertainties (Gunasekaran et al. 2015). Therefore, creating flexibility can be utilized to create a competitive advantage in daily operations. Fast-responding companies can respond

to demand fluctuations and gain market share, while slow responders take the risk of losing it. Thus, investing to flexibility can be justified even without considering the advantages of risk mitigation and cost avoidance. (Sheffi & Rice 2005; Sheffi 2008)

Traditionally firms have adopted strategies to build dynamic flexibility which results efficiency in factories. These strategies are based on the conventional cost accounting methods and pure cost savings. (Christopher & Holweg 2011) Normally risks arising from demand fluctuations can be managed by means of good supply chain management practices, having the right inventory in the right place (Chopra & Sodhi 2014). However, adjusting to uncertain environment necessitates to create adaptable supply chain structures. Strategy of building structural flexibility enables the adaptation structurally accordingly to demand. Therefore, it extends into managing demand-driven exogenous turbulence. This enables fast responding strategies such as adjusting prices or availability of products by having multiple factories according to demand. (Christopher & Holweg 2011) Literature has proven that creating flexibility in both in sourcing and order fulfillment improve the level of resilience in a supply chain (Pettit et al. 2010). While firms build flexibility to respond demand, they are simultaneously building in resilience and vice versa (Sheffi & Rice 2005). According to Rice and Canioato (2003), two capabilities have the greatest potential to create resilience to supply chains, developing flexibility and creating redundancy. These methods have different cost and service characteristics that need to be taken into consideration when designing resilient supply network. (Rice & Canioato 2003) Investing in redundancy is characterized as an increase in costs, while investments in flexibility provides additional benefits to daily operations.

Even though the results of improved flexibility are hard to measure with traditional accounting and risk management tools, there are other aspects which justify the investment in flexibility. Flexible operations offer increased sales, reduced costs and increased competitive advantage. (Sheffi & Rice 2005) Also, investing in reliability and responsiveness of supply chains can be seen as an insurance which buffers against the economic loss from disruptions (Hendricks & Singhal 2005). Supplementing outsourced services to local supplier which has reactive capacity enables to respond to market changes rapidly. Such capacity is not only beneficial to a company when supplier is faced with disruptive event but also during volatile phases, such as periods when introducing new products to markets. (Sheffi & Rice 2005) Although creating flexibility may be more costly option, it provides a chance to reduce the effect of a disruption. At least the trade-offs between lower costs and negative impact related

with higher risk of disruptions should be evaluated. (Hendricks & Singhal 2005) Ultimately, it is recommended that a company adopts a mixture of these flexibility and redundancy alternatives, depending on different cost and service characteristics as well as specific business and industry factors (Rice & Canioato 2003).

In order to mitigate uncertainties, research points out that especially flexibility, information systems, organizational learning and performance metrics are needed (Manuj & Mentzer 2008). Developing flexibility covers essential elements of a supply chain. Literature indicates that incorporating control systems, creating capacity to respond, facilitating a corporate culture which supports resiliency creation and enhancing collaboration between organizations, present potential sources of flexibility for companies (Sheffi & Rice 2005). These are discussed and analyzed in next sub chapters.

4.3 Implementing control & detection systems

The first and most significant phase in mitigating the effects of disruptions is to develop a control system to prevent them. In order to avoid intentional disruptions focus must be put on layering the defense, investing in security measures which are in accordance with company's vulnerability profile, cooperating across enterprises, forming a security culture and include practice and training. (Sheffi 2008) As a result, this improves resilience and protects against disruptions and offers operational efficiencies in the daily basis (Sheffi & Rice 2005).

In a supply chain management context, control systems are linked to the regulation of strategic actions within the supply chain network (Ponomarov & Holcomb 2009). So, assessment of sources of variability need to be conducted in order to understand the impact of variability. The key is to accept volatility, understand its influence to supply chain and to develop hedges against it by creating simple models according to the gained knowledge. (Christopher & Holweg 2011) When the aim is to enhance control across wider supply chain, a more collaborative method to control is necessary (Christopher & Lee 2004). Accordingly, companies should not only control their own operations but also manage the work of their subcontractors. This results new management challenges since closer collaboration and networking has led to the increase in responsibilities of the parties in network environment. (Hallikas et al. 2004) Also, due to the increased use of vertical integration strategies, supplier monitoring is necessary. Suppliers and warehouses should be visited and assessed regularly. (Sheffi 2015)

Research suggests that resilience can be significantly increased by improving a company's capability to detect and therefore also respond disruptions quickly (Sheffi 2015). Increasing the level of visibility within a supply chain can help to locate the disruption source and track the path that disruptions spread throughout the supply chain. The information helps to design supply chain strategy and manage disruptions more effectively. (Blackhurst et al. 2011) Therefore, control systems are suggested to implement. This enables to apply functions which are capable to detect a disruption instantly and foster quick corrective actions. (Sheffi & Rice 2005) Quick detection of disruptions is an important element of mitigating supply chain disruption effects. This helps a company to prepare and improves the capacity to reconfigure resources and create an early response (Sheffi 2008; 2015; Brusset & Teller 2017) Therefore, processes to identify and monitor risks should be deployed to complement flexibility practices (Brusset & Teller 2017). A detailed description of the present supply chain can be developed through process-mapping techniques (Van der Vorst & Beulens 2002).

Consequently, improved supply chain visibility is an essential element of event readiness as the sources of supply chain uncertainty can be recognized (Van der Vorst & Beulens 2002). Warning capability embedded within the supply chain provides mitigation capability for companies. A warning capability can be defined as the interactions of supply chain resources to distinguish an expected or realized disruption. Also, it is about coordination and distributing this information to relevant entities within the supply chain. (Craighead et al. 2007; Hallikas et al. 2004) Control systems also provides improved control of supply chain operations through the real-time data collection and analysis (Gunasekaran et al. 2015). In practice, a lot of companies use shipment visibility systems to detect disruptions rapidly in a supply chain. Tracking systems assist customers to predict late shipments and even discover unusual patterns which can signify of larger challenges. Also, material flows can be rerouted instantly when disruption occurs. Sensitive control systems can even detect a disruption before its affect is noticeable. (Sheffi & Rice 2005) This way, supply chain risk knowledge can improve the event readiness and prepare for unforeseen risk events. This further increases the visibility and shortens the time for detection of the events (Manuj & Mentzer 2008).

Additionally, visibility prevents overreactions, pointless interventions, and ineffective decisions when a disruption occurs (Christopher & Lee 2004). As such, visibility is linked to successful disruption response and recovery (Jüttner & Maklan 2011). Neureuther and Kenyon (2009) suggests that instead of trying to reduce the likelihood of the failure, the firm

should implement a contingency plan, based on the nature and extent of the potential disruptive event. This plan could include for example a safety stock of buffer inventory or dividing the demand among additional suppliers. (Neureuther & Kenyon 2009) Sheffi (2015) adds that business continuity plans, and predefined escalation procedures can be developed in order to help coordinate a response to disruption (Sheffi 2015).

4.4 Creating capacity to respond

Businesses competitive position in network is linked to resilience because of responsiveness capabilities. Companies can solidify their positions if they have market power and are able to respond quickly to changes. (Sheffi & Rice 2005) Especially, in uncertain business environment quick reactions provide advantage (Christopher & Peck 2004). In other words, when creating flexibility within the organization it involves developing abilities to respond (Ponomarov & Holcomb 2009). Also, Trent and Monczka (2002, 2005) put emphasis for the need of speed, in order to keep up with the accelerating changes and pressures that characterize the current business environment. So, creating capacity to respond, not only implies to responding disruptions but also to changing customer demands. Hallikas and Lintukangas (2016) points out that higher risk management performance in a supply chain can be achieved with customer orientation. It ensures that supply chains are aware of the requirements and needs of the end customer and therefore capable to adjust to the changing circumstances fast and thus avoid risks related to supply chain environment.

Research shows that also an impact of a disruption can be reduced by having the capacity to arrange a timely and effective response. This capacity provides optional resources which can be used to minimize effects of disruptions and accelerate recovery times. (Sheffi 2015) Generally, fast response includes use of standard processes and having various locations with built-in interoperability (Sheffi & Rice 2005). Such standardization allows moving resources to where they are needed when a disruption happens (Sheffi 2008). This kind of efficiency guarantees performance with the most moderate resource consumption needed (Fiksel 2003). Additionally, developing logistics capabilities is vital part of creating flexibility. Logistics processes should be capable of delivering an effective response and continuing with business as planned when disruption occurs. (Ponomarov & Holcomb 2009)

Also, having various capabilities at each factory location enhances flexibility to the supply chain (Sheffi & Rice 2005). Flexibility enables the redeployment of existing capacity and

applying resources in the needed area. However, there are costs for designing adjustable operations. Therefore, there is a need developing a multi-skilled workforce. (Rice & Canioato 2003) Enterprises should be able to convert resources to future success with creating the ability to support a broad portfolio with essential capital and talent (Hamel & Välikangas 2003). Mainly these abilities are established by investing in resources and infrastructure in advance (Ponomarov & Holcomb 2009). Resilient companies have distributed power and every employee should have the opportunity to take decisive action in case of a developing disruption. Research shows that in majority of the cases, scope of a developing disruption can be limited by the capability of field employees to act quickly. Consequently, this has the potential to minimize damage. This ability to react is connected to organization culture which is further discussed in the next sub chapter (4.5). (Sheffi 2008)

Sheffi (2008) highlights the importance of creating optional resources and this way redundancy, since it is the first buffer against disruptions. Redundancy provides some protection and helps to absorb some effects of disruptive events. It results the capability to maintain the capacity to respond to disruptions, mostly through investments in capital and prioritizing capacity to needed areas (Rice & Canioato 2003). Redundancy in other words, is the concept of having some resources in reserve, in case of a disruption. Generally, methods such as keeping safety stock, use of multiple suppliers even in the case when the secondary suppliers have higher costs, are common. (Sheffi & Rice 2005; Sheffi 2008) Managing inventory, maintaining production lines, executing contracts for material supply such as buying capacity and maintaining dedicated transportation solutions are essential areas of creating redundancy (Rice & Canioato 200; Pettit et al. 2010). Understanding inventory management can provide a source of competitive advantage and enhance supply chain resilience when the strategic placement of inventory, form and necessary inventory quantity is assessed (Blackhurst et al. 2011).

However, having additional capacity is expensive although there are various ways of minimizing the effect of extra resources and under-utilization (Sheffi 2008). An important difference between redundancy and flexibility is that redundancy includes additional capacity that may or may not be used. This additional capacity is only used when disruptive event occurs to replace lost capacity. (Rice & Canioato 2003) Although every resiliency strategy necessitates some redundancy, it represents pure cost with restricted benefits, except if it is needed due to a disruption (Sheffi & Rice 2005). Although, creating redundancy results

increased cost, it can be viewed as an insurance premium (Sheffi & Rice 2005). Also, Christopher and Peck (2004) suggests that the efficiency versus redundancy trade off should be re-examined, since strategic and selective use of additional capacity may be vital to supply chain resilience. While typically excess capacity has been considered as waste and undesirable, the strategic disposition of additional capacity, can provide a great benefit in the development of resilience within the supply chain. (Christopher & Peck 2004)

Current situation of the company should be assessed, and research shows that the level of exposure should define the measures of response. Rice and Canioato (2003), suggests having a categorization of basic and advanced level of responses. The exposure of risks signifies the level of response, those who are highly exposed to risks are suggested to take the advanced level of response. On the other hand, basic measures may provide enough protection for companies which are less exposed to uncertainty. Companies should response based on company's operational and market factors. (Rice & Canioato 2003) Also, customers point of view should be considered when disruptive event occurs. Organization culture which entails being transparent to customers is important. Having a consistent process for establishing priorities during post disruption period is vital. Combining visibility and fairness of allocation process are suggested, so long-term relationships would be harmed as little as possible. (Sheffi & Rice 2005)

4.5 Developing organization culture

Development of a culture of flexibility is seen as a necessary part of building resilience (Sheffi 2008). Hamel and Välikangas (2003) state that incorporating resilience requires the principle of renewal. Renewal should be continuous and strive for opportunities and not be linked only to occur when company is facing crisis. (Hamel & Välikangas 2003) According to Rice and Canioato (2003), organizational capabilities pose one of the most powerful resources to improve security and resilience. Most successful companies have been able to make resilience part of the organization's culture. Research further indicates that the establishment of a risk management culture in the organization will improve the resilience in the supply chain (Christopher & Peck 2004).

The right mindset of a company contributes to flexibility and resilience. Continuously questioning prevailing knowledge and having a culture that allows to be heard, understood, and acted upon is important. (Sheffi & Rice 2005) There should be a state of willingness to

be aware of changes and continually evaluate possible effects of these changes (Hamel & Välikangas 2003). This is vital since in many cases disruptions happen suddenly. Therefore, situational awareness and initiative closest to the event, play an important role. It is significant to encourage front-line employees to take actions quickly based on the event. (Sheffi & Rice 2005) Flexible organizations enable employees to act if they spot a problem, since their instant reaction can prevent it from escalating (Sheffi 2005). This calls for continuous communications so in case of a disruption, people know the accurate status of a focal company (Sheffi 2008). This provides mitigation capability for supply, and it provides recovery capability for an organization. Such interactions and coordination of resources enable interference and normal level of product flow can be returned. (Craighead et al. 2007)

Organization's leadership capabilities can also improve company's security and resilience (Rice & Canioato 2003). Managers have the responsibility to foster continuous dedication to communication and collaboration at inside company and between supply chain members. Also, risk awareness via training and education should be offered if there is a goal to build resilience (Scholten et al. 2014) since according to literature knowledge and training of employees can increase resilience of a supply chain (Blackhurst et al. 2011). Furthermore, leading companies have reported to educate their stakeholders about resilience, security, and supply network risks. Creating flexibility is achieved mostly due to enterprise-wide training on the topics of resilience and security and furthermore incorporating these into daily operations and decision-making processes. (Rice & Canioato 2003) As a result, organization culture contributes to resilience by providing principles considering the proper response when a disruption occurs (Sheffi 2005).

4.6 Enhancing the level of collaboration in supply chain

Inter-organizational relations are an important part of creating resilience. Relations are extending beyond the boundaries of single firms. Therefore, performance of whole entity of organizations has a great impact on the end customers satisfaction. Thus, collaboration in supply chains is viewed as necessary part of operations. (Lavastre, Gunasekaran & Spalanzani 2014) Improved supply risk performance and collaboration with suppliers has proven to have a strong correlation (Hallikas & Lintukangas 2016). Previous research has shown that firms can attain significant effects when partnerships are properly performed. Strategic collaborations correlate positively both to supply chain responsiveness and market

performance. (Kim & Lee 2010) Moreover, building collaborative relationships across the whole supply chain is very beneficial for developing flexibility and reducing uncertainty (Stevenson & Spring 2007). Since supply chain vulnerability is a network wide concept, also the management of vulnerabilities must consider networks. According to research, collaborative work across supply chains can help to considerably mitigate risk. (Christopher & Peck 2004) It is also vital if the aim is to improve control across wider supply chain (Christopher & Lee 2004). In the creation of a more secure and resilient network, developing deeper relationships with suppliers and customers is essential (Rice & Canioato 2003).

As a result of better coordination within the supply chain partners, the effect of disruptions can be mitigated (Hendricks & Singhal 2005), since working collaboratively in the supply chain context supports the exchange of information and therefore can diminish uncertainty (Christopher & Peck 2004). Inadequate information sharing is a significant source of uncertainty and costs in supply networks (Hallikas et al. 2002). Collaboration is seen as the force that unites operations (Fiksel 2003). Also, early involvement of partnering firms can help to conquer supply chain uncertainties in supply chain operations (Ponomarov & Holcomb 2009).

In order to reduce uncertainty, a key priority should be the creation of a supply chain community to enable the exchange of information between members. The goal is to develop a high level of "supply chain intelligence" which results better visibility of upstream and downstream risk profiles. (Christopher & Peck 2004) Collaboration with suitable partners ensure the exchange of information (Gunasekaran et al. 2015). Enhancing collaboration and visibility in the supply chain improves the detection of risks and therefore managing these becomes easier (Vilko & Hallikas 2012). Informative suppliers help to reduce supply vulnerabilities by detecting early signals of supply chain disruptions. Hence, adjustments on operations or strategies is possible (Yan et al. 2015). Moreover, resilience involves especially developing supply chain relationships that are transparent (Christopher & Peck 2004). Complexity is reduced in a transparent supply chain, because of improved end to end visibility, order processing, inventory status and distribution (Gunasekaran et al. 2015).

Especially information sharing, trust and commitment have been characterized as success factors of collaboration (Kähkönen 2014). By means of sharing forecasts and sales data and allowing continuous inventory alterations, collaboration can be improved (Brusset & Teller 2017). Moreover, collaborating enables to utilize suppliers' capabilities to sensor market

trends and therefore they provide informational value to firms. This helps the focal company to adapt market changes. (Yan et al. 2015) Also, cooperating with logistics service providers enables to utilize track and trace technologies. This provides advanced cues about events and problems that have effects to service levels and quality. (Brusset & Teller 2017) According a study conducted by Vilko and Hallikas (2012) both operational and supply environment pose the most significant risk sources. These cause mainly time-delays. Therefore, applying proper risk management related to mitigation or respond to these issues is suggested to be beneficial in present-day intensively competitive environment of logistics. (Vilko & Hallikas 2012)

Also, opportunistic behavior can be reduced by having common planning procedures (Hallikas et al. 2002). It is recommended that supply chain parties share information in real time by having well defined communication channels. Using the same enterprise resource planning systems is recommended, so that collaboration in supply chain could be improved. (Gunasekaran et. al 2015) This how information flows fast and efficiently and costly delays in deploying mitigation strategies can be prevented (Blackhurst et al. 2011). When both integration and flexibility capabilities are combined and developed, resilience is also created. So, not only information technology tools should be utilized in order to integrate their internal organization, but also other supply chain management software should be used to incorporate their customers, suppliers, distributors, and logistics service providers. (Brusset & Teller 2017)

Research also shows that creating collaborative environment is essential since it enables a collaborative response. This enables building of joint processes and allocating resources. (Sheffi 2008) Regarding to supply responsiveness and supply risk, some critical suppliers in the supply chain network should be identified. Due to the power relation characteristics of these suppliers, they are hard to substitute and essential for maintaining normal operations in supply network. Therefore, the importance of these suppliers is emphasized in a turbulent business environment. By ensuring continuous and timely supply from these suppliers, firms can design more resilient and responsive supply chain. (Yan et al. 2015) In addition to response, recovery can be also improved through collaboration, since the knowledge after disruption can be utilized and shared among the parties (Jüttner & Maklan 2011). According to the research conducted by Rice and Canioato (2003) businesses which had better level of response were able to learn from experience. They designed their supply networks to be resilient as well as secure by emphasizing supply chain collaboration, intensive training and

education, and sound strategy development. In addition to integrating knowledge from outside the company, creating new knowledge within an organization is important (Nonaka & Takeuchi 1995). Organizational capability to learn from practice must be shared collectively. Developing such organizational learning mechanisms facilitates a firm become a resilient organization. Thus, environmental changes can be proactively handled. (Nonaka & Toyama 2007)

Relationships need to be established by having a long-term strategic contract and sharing technologies (Gunasekaran et al. 2015). However, while collaborating is an important part of developing resilience, it is also vital to notice that not only strategic partners should be involved. Certain suppliers may become bottlenecks which limit the speed of the expansion or recovery due to their position in a network. Therefore, developing a collaborative relationship is suggested with certain suppliers to provide support during disruptions and enabling better recovery. (Yan et al. 2015) Kähkönen (2014) points out that firms' power positions in the network has influence to the depth of collaboration. Especially when there is a great dependency between firms, this results greater exposure to other firms risks. Therefore, power and dependence relations should be added to planning and developing supply strategies (Kähkönen 2014). Consequently, aiming at sharing and balancing risks and rewards between firms is perceived as the most optimal strategy (Hallikas et al. 2004).

5 EMPIRICAL FINDINGS: VULNERABILITY ASSESSMENT

Empirical part of this study has divided into two areas. As identifying the potential disruptions and defining the level of vulnerability that exist in a supply chain is recommended in order to manage supply chain vulnerability (Chopra and Sodhi 2004; Manuj and Mentzer 2008; Wagner & Neshat 2012), the first part of empirical study assesses multiple scenarios which may cause challenges and vulnerability areas for the case company. This assessment is carried out by using the Risk Assessment Model by Hallikas (2001). The risk assessment model represents a series of different scenarios. These scenarios are divided to three different categories. First category examines different types of demand related challenges which may arise from the case company's demand factors. Secondly, case company's cost management and pricing models related events are assessed. Lastly, evaluation of events regarding the

fulfillment of orders and delivery reliability are conducted. Case company's representative assessed these scenarios on a scale of 1-5, based on the evaluation of the severity of consequences the event would have on the case company's operations, and the estimated likelihood for this scenario to take place. In addition, the effects of events are analyzed to create a better understanding of the scale of impacts. The objective is to detect possible vulnerability areas in order to create a comprehensive understanding of the current situation of potential vulnerabilities, so that further prioritization and suggestions can be made for future management actions.

5.1 DEMAND

Demand related problems consider vulnerability areas arising from demand fluctuations and consequences of small numbers of orders. The aim is to identify possible events which may cause vulnerability areas and furthermore evaluate the impacts by vulnerability mapping. More precisely, demand related problems are divided into four categories which are analyzed separately. These categories reflect the evaluated consequences for the case company when demand from a major client decreases (1-2), problems related to situation where significant clients' product sales arise (3-6), consequences of the positioning as part of supplier network (7-15) and effects to case company's volume when their suppliers have issues related to production (16). Figure 4 summarizes the overall positioning of demand-related uncertainties according to the vulnerability mapping.

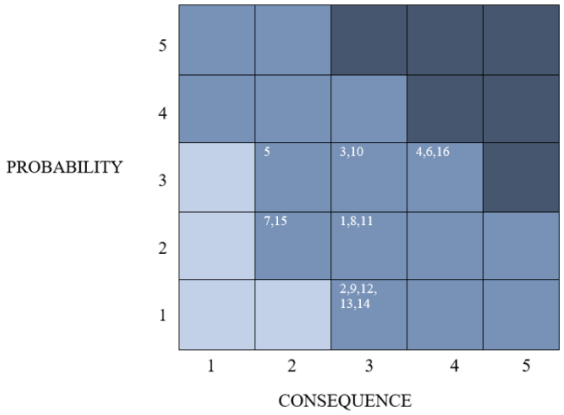

Figure 4. Vulnerability matrix of demand related events (adapted after Zsidisin & Ritchie 2009)

As the table shows, great majority of demand related scenarios cause moderate effects. However, according to the estimates most of these scenarios have only a very small to small likelihood to take place. Also, assessment model indicates that there are few scenarios that

have scored reasonably high in both consequences and probability to occur. In other words, there are three events which may take place quite likely and have some severe consequences. In the next chapters these are examined more detailed.

Assessment of demand related problems firstly maps out shortly the background of the case company. A set of questions were asked to create understanding of the current situation of the case company's products demand. As a result, there is a clear emphasis on one major customer, however there are enough potential customers and demand outside current customers. Therefore, constant search of new potential customers can be done. Also, case company has experience and knowledge from marketing and acquiring new customers, so this can be used as an advantage when acquiring new customers.

5.1.1 Demand of the customers

The first part of evaluating the case company's demand related uncertainties concentrates to assess the effects of declining demand, and the impacts of abruptly stopping industry growth. If the demand in the industry declines, it is evaluated to have moderate impacts to the case company, however estimated likelihood to decreasing demand is low. The company is accustomed to seasonal demand fluctuations, and these fluctuations are characteristic to the market area. Though, it seems that demand stays quite stable in the long run at case company's industry. Naturally, declining demand has impacts to case company's profitability at least in the short term. However, case company has divided the customer portfolio, so it could concentrate sales for other target markets if demand is suddenly decreasing from a major customer.

Scenario of a generally declining demand and unexpectedly stopping growth in the industry is however more likely to occur, compared to economic downturn in an industry or geographical area with a significant number of end customers. Economic downturn would cause diminished sales and loss of profitability, but case company has kept its structure quite flexible to adapt to challenging times. Company has the advantage of adjusting to demand fluctuations since it can react fast with minimizing the company's inventory, therefore maximizing the company's liquidity. The latter was estimated to happen very rarely in the industry of case company.

5.1.2 A significant client's product sales

Second part of the evaluation of the possible demand related vulnerability areas assesses the problems related to the situation when some significant customer has problems to sell their own products. If significant customers' competitiveness of products is weakening, this is predicted to have some impacts to the case company as well. This scenario is seen somehow possible to occur and it impacts on customers order base and would result in lower order quantities. As a result, sales would decrease, and the amount of goods supplied should be adjusted accordingly. This would influence the company's business until customers' business recoveries.

However, the case company is not relying on customers' new product launches. If customer's new product model or its timing fails in the market, this has predicted to have only little impact on the case company. This scenario is quite likely to happen in the field of case company.

According to the risk assessment model, more uncertainty would arise from inaccurate order forecasts provided by customers. When order forecasts provided by the customer do not materialize, this can potentially cause severe consequences to the case company's business. Estimation for the likelihood for this event to take place is rated to be moderate. This indicates that it is not uncommon in the case company's field that customers' predictions of orders fail, and consequently there is mismatch of supply and demand. One reason behind inaccuracies in customers forecasts is the seasonal fluctuations in demand. If the customer's order quantities remain lower than predicted forecasts provided by the customer this causes extra stock for the case company and insufficient inventory turnover. Furthermore, in practice this causes extra work to find new customers for the product. Also, there is a risk that if new customer is not found fast enough, product's profit margins decrease, or the product is not sellable anymore and causes financial loss. On the other hand, it is also possible that the actual sales would be higher than predicted in forecasts. In that case, there will be a shortage of sales items. Forecasts provided by customers are straightly linked to the supplied amount of goods. Negotiations about supplied amounts are based on these evaluations of sales forecasts and since the goods are supplied in advantage, the amount cannot be adjusted after negotiated amounts of goods. Therefore, inaccurate sales forecasts can also result in loss of sales.

In addition, in this category of problems related to a significant client's product sales, there is one more major source of uncertainty which causes a possible vulnerability area for the case

company. According to the vulnerability mapping, if customer's customer does not trust the delivery capacity of the network, it has severe consequences. This is not uncommon in the market area of the case company and it is estimated to have moderate likelihood to occur. Consequently, this event was recognized to pose a high level of uncertainty in the category of demand related uncertainties. So, customers' trust to the delivery capacity of the network plays a of key role in the case company's supply network. It is important for case company's customers to know in advance if the products are available, or if there occur some delivery challenges in the supply chain, so that they can further react and inform their customers. In other words, case company's positioning in the supply chain is dependent on the delivery capacity. Otherwise, customers may start to place orders from substitute suppliers and competitors if they are not able to order products from the case company.

5.1.3 The positioning in the client's network

Third part of the questionnaire concentrates on evaluating the case company's position in its client's network. A set of questions of potential occurrences that weakens the position of the company as part of the client's supplier network were assessed. There are several occasions regarding the case company's network position which have been estimated to cause moderately effects for the case company. Primarily these were estimated to have very low possibilities to take place.

Firstly, the case company estimates that the possibility of disclosing confidential information is very unlikely. There is only a limited number of employees who have access to confidential information. They are also aware of their responsibility linked to confidential information. Additionally, non-disclosure agreements are established with majority of the largest clients if necessary, to secure the confidential information, so that the information is not passed on from the parties involved. Yet, this kind of leak would have a long-lasting impact on businesses' reputation as their reliability would be questioned.

Company also estimates that the possibility is low for a situation where a client would require a change in technology or volume that the company would be unable to meet. There is well established technology between case company and clients. Moreover, case company's technology is constantly evaluated, that it meets the requirement of both parties. In terms of volume, the amounts can be adjusted quite flexibly depending on the supplied items. Supplied

amounts for regular products can be adjusted on a short notice. If not, it would have only short-term problems related to delivery capacity and cause some problems fulfilling orders.

Moreover, it is estimated as very unlikely that the customer finds more competitive suppliers outside the network. While this would potentially have some impact on case company, it is not considered as a threat to network position. For this scenario to take place, it would require an economically strong supplier with competitive prices and top-class quality of products. Potentially this would result in price negotiations and cause some defeats in yearly negotiations with clients in some product categories, as product categories are negotiated separately. Since the case company has several different product categories it also shares the risk in this case. Therefore, consequences of this scenario would not be severe.

Also, a scenario where the company's position in the customer's network would weaken because the company does not have the resources for the internationalization required by the customer is very unlikely to happen. The case company has the aspiration to be increasingly involved in international trade. Nevertheless, internalization is something which is increasingly creating competition for businesses so it should not be disregarded, and this is creating pressure for companies overall. This is regarded to have some impact on the case company's network position.

There were also a couple of scenarios that were estimated to have small likelihood to occur with having moderately consequences on case company's operations. First of these scenarios is that the customer reduces the number of suppliers. This is regarded to have small probability to happen. But if a customer decreases the number of its suppliers leading to the situation where the case company is dropped out, it could impose a competitive situation and loss of sales for the case company, at least until the organization would found alternative sources for sales.

Secondly, the other event considers a situation where the case company faces challenges because of lack of customer trust due to quality issues. The case company estimates that the issues related to customers trust of quality would have some impacts, since it can potentially reduce the number of orders and affect sales on short term. This can also eventually harm brand image in the longer view, if severe quality issues would occur with large quantities of the products continuously. However, in the case company's field, occasionally happening quality issues are not regarded as detrimental for the business. Occasionally happening quality

issues with part of the delivered products are regarded as somewhat unavoidable due to the nature of products and deliveries. Delivery may cause some damage to the products easily if they are not loaded in the right manner. Yet, case company's business logic is based on delivering superior quality compared to other competitors, so there is continuous monitoring of quality and delivery manners. Also, constant work is done to guarantee the highest quality possible. Quality is ensured by close collaboration with suppliers and clear product specifications. Additionally, customers can always make a claim of goods if they are not satisfied with quality.

A more probable scenario related to losing customers trust is connected to low reliability of deliveries. This scenario has been estimated to be quite possible to take place. If this scenario is realized, it has been evaluated to have some impacts on the network position of the case company, since it would have an impact on the business both short term and long term. In the short view, if there are delivery issues, it can contribute to cancelled and reduced purchase orders. Some customers do not accept late deliveries due to their own schedules and closing times. As a result, delivery dates cannot be delayed or transferred and then the delivery is cancelled. So, loss of sales margins would materialize in some cases. Overall, this would impact the profitability of the case company. Insufficient delivery reliability would ultimately contribute to the loss of trust and could materialize as cancelled business deals and worst-case scenario, customers would change the supplier of goods. Especially, if a major customer is concerned this would correlate straight to sales and profitability of the case company.

5.1.4 Effect of other suppliers in the network

Lastly, the assessment of vulnerability areas related to demand concentrates on issues regarding other supplier's production problems and how these difficulties impact the case company's volume of orders. When there is a capacity problem in the network, this is strongly linked to case company's delivery capacity and stock levels. This has a great impact on the case company's ability to deliver, causing restraints to reliability of delivery to customers. As a result, products delivery time to customers may be prolonged, if there is not enough safety stock left at that moment. Consequently, this may cause dissatisfaction among customers whether there are long delivery interruptions. Therefore, there will likely be noticeable short-term effects on profitability as sales would decline because of potential cancellations of purchase orders. Thus, this has been evaluated to have significant effects to case company

with evaluation of severe consequences. However, effects depend on the supplier; case company has own supplier for each product category. Therefore, there is a different level of substitute products available in the case company's product selection. Also, the supplied amounts vary greatly so the consequences would depend also the supplied product in question. Products also vary in the level of products sold, so they have different value for the outcome of sales. In addition, this is estimated to be quite likely to happen in the field of case company. Occasional disruptions in supplier's production can occur.

5.2 COST MANAGEMENT AND PRICING

Second area of vulnerability mapping is composed of problems in cost management and pricing. These are divided to separate areas which map out problems related to different areas of cost management and pricing. These are divided to different challenges linked to: problems in calculating or controlling production costs (17-21), wider responsibility and larger production quantities place additional requirements on the company's operations and costs (22-25), increased investment costs (26-34), the price or availability of money causes difficulties for the business (35-37) and product pricing related problems (38-46).

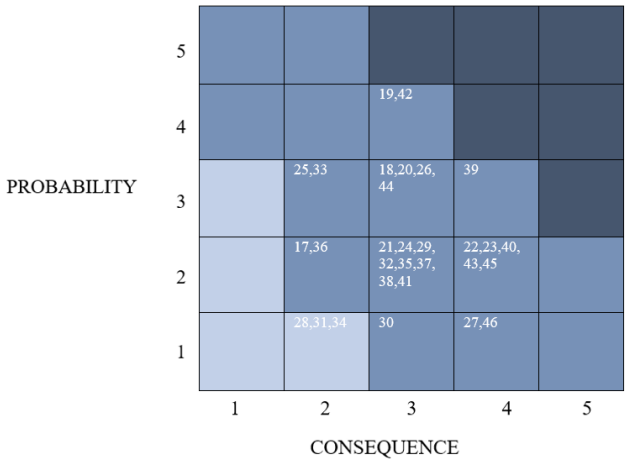

Figure 5. Vulnerability matrix related to cost management and pricing related events (adapted after Zsidisin & Ritchie 2009)

Vulnerability mapping shows in the Figure 5 that predominantly cost management and pricing related uncertainties have a small likelihood to happen. Few occasions were estimated to be somehow possible and only two scenarios had a great probability to happen. For the most

part, these challenges are resulting in either moderate or severe consequences for the case company. These scenarios are analyzed further.

First background questions were asked regarding case company's cost management and pricing. According to answers there are estimates about customers' end products cost structure and company's part of that. Also, pricing is done open book with some customers. Additionally, working in the supply network has had some impact on product pricing and resulted in changes to price levels. Also, operating in the supply network has changed the case company's cost management to some degree. In addition, there is cooperation with customers to lower costs to some extent.

5.2.1 Calculating and controlling production costs

Two occasions related to problems in calculating or controlling production costs were estimated to be unlikely to occur. First would have only little impact and second would have already more impact. While labor costs usually have a great impact on company's profitability, the increase in labor costs is estimated to have only a small effect for the case company. It has been taken into account in case company's cost management that labor costs may fluctuate yearly. Second scenario which is estimated to have a low likelihood to happen, is that production equipment would not be capable of cost-effective production. The case company has outsourced production to specialized producers who have required equipment and facilities to produce goods. So, own production is not necessary for the case company. However, regarding the product launch of the new concept there is dependence on own production. This concept is relying on its own production equipment, so it would naturally influence production efficiency. Yet, the estimated probability for production equipment not to be cost efficient is low since the equipment is new and in good condition. Production equipment is also optimized considering cost efficiency. Also, if issues occur with production equipment, there are repairing services available. Therefore, estimated effects remain moderate. This kind of challenge would have a short time impact and result in a short period supply shortage.

According to the case company's estimation, more probable scenario of challenges in cost management would be that costs are not flexible when volume fluctuates. There are demand fluctuations in case company's market as mentioned earlier. Fluctuations may occur due to seasonal changes in market demand. However, there are naturally fixed costs related to

operations which do not change when the operating rate fluctuates. Moreover, there are variable costs that depend on the ordered volumes from suppliers. There are typically subcontracting services purchased for production activities, so these are realized when goods are delivered to the case company. So, if case company's procurement places a purchase order for a large quantity of products and customer's orders do not match up, there would be excess stock which results in costs being already realized. Yet, the company has been able to adapt to some extent to demand fluctuations by implementing the Fifo-method for procurement. This is used for stock rotation, with the oldest stock being sold instead of the latest arrived stock. The aim of following this principle is to prevent loss of sales due to short shelf life.

Loss due to quality issues is also an event which is quite likely to realize. There may realize some financial losses due to the nature of the product since there are variations of products shelf life. Some products have quite short shelf life which may cause challenges for sales. Also, transportation may harm products easily. Losses depend on incoterms and the agreements of the time when the responsibility transfers between parties. If suppliers sell goods which end up been contrary to the agreement, case company can make a claim and therefore is justified for credit. However, if a product is harmed during case company's logistics partner on the way for customer, it is case company's responsibility to compensate for this. As a result, some monetary losses may realize. However, scale of losses stays quite low since quality issues are usually concerning minority of delivered products. The case company has strict quality control and if large quality issues arise, there is negotiations about resolving these in order to prevent monetary loss.

Like earlier mentioned, demand fluctuations are characteristic for the market area of the case company. So, it is very likely that difficulties in the predictability of demand imposes additional costs. This is causing some additional costs related to warehousing and freight costs. Though, it is not regarded as more of a difficulty in the longer period, since purchased quantities can be adjusted.

5.2.2 Wider responsibility and larger production quantities

Primarily case company has the responsibility of buffer stocks. The size of the buffer stock is estimated in relation to estimated sales. Estimated impacts would be moderate for a scenario where responsibility of buffer stocks would be transferred from the customer to the case

company. Since the case company has principally the responsibility of buffer stocks, it means in practice that sales forecasts are carefully followed and ordered amounts from suppliers are adjusted accordingly to the current demand. This may mean realized losses if there are not enough orders placed by customers. Also, this risk related to the responsibility of keeping buffer stocks would be realized especially with the products that have short shelf life. Therefore, there may be a risk of carrying extra inventory. On the other hand, if the buffer stock is not sufficient, there is a risk of running out of goods.

If responsibility for buffer stocks is transferred from the case company to suppliers, it would only have a small effect. It is however more likely that suppliers have shortage of goods during the high demand seasons. This has been evaluated to have only small impacts, since case company's main suppliers have certain responsibility to include case company's estimated needs for the goods. The case company provides their estimated sales forecast and need for the products supplied. Supplier then confirm these amounts and include these in their own production planning. The suppliers are producing approximately the amount that case company orders from them and delivers these to the case company's warehouse. Also, shortages can concern some ingredients of specific products, so economic effects remain small.

There are two scenarios that would have some severe consequences if they would take place, both consider the effects of working capital. If either of scenarios of working capital grows unnecessarily large as business volume increases or working capital increases due to material responsibility and larger entities, it would cause damaging impacts to effectiveness of the operations. Yet, it is estimated that these scenarios are unlikely to happen.

When estimation of supplied goods is too high, stock may increase excessively. There may be a risk then that days in stock increases and there would be excess stock remaining. Thus, there may be challenges if products remaining shelf life is short and these items are not sold early enough. This increases the number of current assets. However, the likelihood for this is small since in a corporate level case company can allocate goods effectively, so optimization can be done regarding products. Previous concerns also the case of working capital increasing due to material responsibility and larger entities. Case company has no substantial material responsibilities, and packaging materials are relatively inexpensive. Also, used production equipment can be resold if necessary.

5.2.3 Investment costs

Overall different scenarios of rising investment costs are estimated to have only small or moderate consequences for the case company. Initially, there is no pressure for bigger investments experienced by case company, and investments are directed according to the needed areas after careful evaluation. Also, the case company is considering that internalization is not posing great investment needs currently, as case company is a subsidiary of a corporation which is more probable to make decisions about internalization. So, these situations would have only small effects for the operations. All the investment decisions are estimated based on the current state of case company and the need for investments. All investments are planned accordingly to strategic needs.

However, if wrong investment is made, it is estimated to have moderate impacts. The impact would naturally differ on the type of investment. This is though very unlikely to happen since all investments are carefully estimated and strategically planned like earlier mentioned. Nevertheless, while investments are carefully planned, a more probable scenario would be that decision criteria of the investment would change after investment is made. Then there is the risk that estimated investment income or expenses at the time of the investment are not realized as estimated. Real expenses are quite difficult to estimate in some cases beforehand if some disruptions or unexpected happens. This also depends on the type of investment. For example, an accurate number of investments in creating own production is hard to estimate since some unexpected occasion may create more expenses than estimated. Realized investments may then be higher due to the new situations coming with setting up production lines and own production.

More probable scenario than previous would be that a customer-specific investment is made which has no use after a product fails. This would have only low impacts since customer specific investments are not large-scale investments currently. So, these do not have such considerable financial impacts even though this kind of investment would not be successful. Also, product range already includes products which are requested by customers. These have been taken to the product line after customers' needs and requests. However, these products are generic in a way that they are also suitable for other customers. The case company's objective is to do closer collaboration with the end customer. This kind of partnership would include customer-specific products. However, case company's suppliers would produce these

goods. Product characteristics, labeling and price would be negotiated with the customer beforehand. Then, the case company would supply the customer specific product with customers packaging and labeling from its own suppliers. These material costs would be a cost for the case company, however material costs are evaluated and calculated before a certain price is offered to the customer. Nevertheless, if the customer specific product's sales would not realize as expected and the product would be decided to withdraw from the market, material costs would quite likely remain to be paid by the case company according to contract. Yet, practice has shown that this risk linked to material costs can be shared with customers.

If the investment cycle would accelerate, it would have some impacts on operations. This event is evaluated to be unlikely. There are certain priorities in the case company's strategy which support how investments are planned and executed. However, there may arise unexpected needs that are not planned before-hand and these may have significant impacts. As a result of launching new concept, it is estimated to be quite unlikely that the investment cycle would accelerate because of the need to keep up with growth or customer development.

Most probable scenario related to investments is estimated to be that expansion investments increase company's gearing. This would have some effect on the financial status of the case company. There is a fair chance for this to happen as well. Effects of this scenario would depend on the type of investment and type of funding. These consequences would be moderate if there is operating funding or debt financing in concern. While planning the case company's next strategy season, it has been taken into consideration, whether there is a need for different investments for the new concept regarding expansion.

On the other hand, the most critical investment related scenarios would be that the size of the investment increases too much in proportion to the company's resources. This has ranked very high on the assessment of consequences it would have for the company. It is estimated to have detrimental effects in total. Although, likelihood for this to happen is very low since the case company is a subsidiary of a financially strong group concerning turnover. Also, the owners of the company have experience in the past of this kind of investments and financing models. Furthermore, investment criteria are evaluated carefully so likelihood for risk investments is low. Financial consequences of all investments are evaluated beforehand in order to avoid certain financial risks.

5.2.4 The price and availability of money

If there are changes in the price of money it has only small to mediocre effects to the case company. Three different scenarios of monetary fluctuations were estimated. All of these were evaluated to have small likelihood to occur. Firstly, if exchange rate fluctuates resulting in interest rate losses or margin problems, it is considered not to have significant impacts. The case company does business with three different currencies, so there are certain forex hedges made. A certain course is negotiated with the financial institution, for a certain period. Consequently, exchange risk can be minimized even if quick fluctuations would occur. There have been fluctuations in some currencies, but this has not resulted in any major challenges for the operations yet.

Moreover, if interest rates would rise sharply, it would have more impact than previous scenario but only to some extent. Cooperation is done with financial institutions, so that risk classification of the case company would be as good as possible. Also, information is shared with financial institutions to create a good basis for evaluation of case company's performance. Thus, financial institutions have more likely no need to create additional marginals. Therefore, rates which are close to market interest rates can be reached.

Also, there are no concerns that funding would be a bottleneck for business development and expansion. If funding would be a concern, it would naturally cause some challenges for the business. Whole corporation behind the case company has a strong balance sheet so it would be quite unlikely that financing would set boundaries to the operations. According to the results there are no considerable vulnerability areas in this category.

5.2.5 Pricing

Risk assessment model indicates that pricing of the product poses some vulnerability areas for the case company. There are considerably more uncertainties in this category compared to other categories concerning cost management. While there are some cases of pricing which have some effects, there are also some events that may cause severe consequences if they take place.

According to the results, case company's pricing model seems to be working properly since the likelihood for company's own pricing to fail is considered low. If the company's pricing

would not be on a suitable level, it would have some effects to case company. Though, there is lots of knowledge about product pricing, sometimes risks are taken since the prices are agreed months in advance. Therefore, the exact price development is not known in the deciding moment. The case company purchases products at a certain negotiated price and sells the goods forward to customers. Pricing is based on competence and on the other hand, a capability to take risks. Also, since prices are negotiated so much further into the future, there should be a risk premium considered while pricing. If it can be assumed that the price level is going to rise and sales prices are already negotiated, risk premium enables better balancing with fluctuating purchasing prices and sales prices. Therefore, there is a risk that realized profit is not as planned if price levels fluctuate. Also, the impacts depend on the product type. Impacts of this kind of unfavorable price level development may have quite major effects especially monthly if it considers products with great sales. However, there are contractual relations with main suppliers and cooperation is done long term, so it is unlikely that the pricing model would fail.

However, it is quite common that product pricing does not work properly in all situations due to the nature of the field that case company operates in. This is also considered to have some effects but nothing severe for the case company. These challenges are strongly related to quality and perceived value. A good example of a scenario related to this issue is that a considerably higher price is set for a product, which differs from substitutive products prices in the market. Determined price level is however incompatible with competitor's products prices since the item is in a different price scale due to the better quality. In which case, the price does not correspond to the need that exists in the product category. There are goods in some product categories of this kind, where products are sold with higher price compared to competitors. However, the products are considerably better quality, in other words a completely different product is sold. This means that product pricing has not failed, but the market segment is different.

In addition, customers have great power over the price of products which causes some inaccuracy to the pricing model of products. Thus, this is quite a common case, and it is continuous negotiation over the prices, so that both parties would be satisfied with results. According to the case company's estimation, distribution of best-selling products is concentrated to only few customers. Therefore, customers have a considerable power when negotiating prices. It depends on the customer if the prices can be negotiated. So, the results

of this scenario depend on the situation. It is estimated case by case how big impacts it would have if a sales deal would be lost because of the price, and if the customer would acquire the product from another supplier. It requires evaluation of tradeoff between market position and profit. Sometimes it may be a better option to close a deal with price required by a customer, even if it would not be a profitable deal and thus protect market position. Impact of this scenario also depend on the product series in concern. Some product categories prices are negotiated monthly and some 3-4 times per year. The aim is to maintain a stable price level and to allow easy trading. Price development is monthly followed.

Also, if some large international competitor would enter markets and potentially lower the price level, it would have some effect on the pricing policies of the case company. However, this scenario is estimated to have only a small likelihood to happen in the market area of the case company. The case company reports that this kind of situation can occur from time to time among the case company's big customers. These customers negotiate with case company's competitors both domestically and internationally. It would naturally have big effects if some large international competitor would enter markets. However, it is quite unlikely that this would become a significant challenge on a large scale, since those companies which have entered the markets have withdrawn after operating sometime in the market area. There have been these kinds of situations in the past but in the longer view these companies have dropped out of the market even before COVID-19 took place.

Nevertheless, in this category several events were found which would result in severe outcomes for the case company if they would take place. Even though, mostly these were estimated to have small possibility to happen. Based on the evaluation of the case company's view, it is significant to recognize the added value that product has to offer for end customers. It is ensured and evaluated that there is full awareness of the added value of products in the case company. According to the case company, it would have fatal consequences if added value for customers would not be known, since it provides an area of strength and a source of competitive advantage. Case company's market position is defined by this competitive advantage. If this added value would not be known, it would have substantial financial consequences. It would also result that areas of operations would not be recognized and developed systematically. Possibilities for this scenario are very low because case company's operations are based on this strength and it would be fatal for the whole business to lose this area of expertise.

There are three scenarios that are little more likely to take place than previous ones and have also a significant impact on the operations. These vulnerability areas concentrate strongly on market related events. Firstly, if there would start a fierce price competition or price levels on the market would continuously decline, it would have severe consequences. These would have negative impacts on the profits and weaken the company's profitability in the short term. Estimation for these scenarios to occur is considered low.

If a fierce price competition would start in the marketplace, it would have significant and severe economic effects for the case company. The case company evaluates that most likely there would not occur drastic decline of prices in product categories. However, time to time price competition occurs. In some cases, case company must defend and aim to maintain its market position even if it would not be profitable. The aim is not to give space for competitors since if they are able to take some shares of the market, it may have effects to other product groups' profitability as well. Consequently, the delivery volume for customers may decrease to such extent, that relative profitability will suffer in other product categories as well. Therefore, the goal is to maintain the market position achieved. Purchase price is an indicator for case company's price level, and the price change cycle is different for different products.

Continuous decline in prices is strongly linked to prevailing positions in the case company's market area. Constant decline in price levels is usually an indicator of competitors which are aiming to take the case company's share of the market and market position. In that case, the case company must respond by lowering prices in order to maintain sales. Yet, this may have negative financial impacts and lower revenues. This would result in considerable effects since it may even affect the entire fiscal year, causing weak profitability. On the other hand, this is not very likely to happen since case company operates in a field in which events can be followed quite easily. Therefore, responding to other parties' actions is possible. While in some cases responses can be formulated, there are also universal factors which affect the whole field, for example COVID-19. Hence, a single actor cannot then make completely divergent decisions related to prices since events like that impact other actors in the market area too.

Also, if a customer would require unreasonable reduction to product price in a short notice, it would cause trouble and have high impact on the business. Though, it has been also estimated to be unlikely to happen. While it is estimated to occur seldomly, there is a risk regarding customer's position. If a customer is aware of having a strong negotiating position, this could

cause some challenges to price negotiations. This could fast lead to requirements of reduction of the prices since customers would be able to decide a price and decline other offers by appealing that otherwise products are supplied elsewhere. However, the impacts are relational in the short term, since there are customers that have specific selection periods for products and pricing policy is strongly linked to these periods. If there are campaigns, prices can be negotiated considerably lower compared to normal. However, if a new competitor or considerably cheaper substitutive product enters the markets, it may result in instant negotiations and tendering between the case company and customers. This kind of bidding may have significant financial effect, especially in uncertain times like during COVID-19 when stock management has been challenging. Also, due to market situations there may occur push sales on a short notice. For example, a product is offered at a significantly cheaper price in order to decrease stocks for a certain period of time. This type of situation may occur and have significant impacts to case company's operations.

More likely than previous scenario is that market price determines the price. This is result of external factors which have disturbed markets in a short term. Some other similar factors may occur and due to COVID-19 uncertainty prevails about price competition. It remains to see if the markets will recover and open during the next summer. The outcome of this will have a significant effect to price levels and market position in the case company's market. If the prices would rise considerably, there will be competition of product availability among suppliers. Most likely the actor who is ready to pay the most is going to achieve a good position in the market. It would also have substantial effects for customer demand. Then customers may not be willing to pay for case company's products if the price of the case company's products reaches the level of competitors substitutive domestic products. On the other hand, availability of products may be restricted. However, if price level cannot be matched with market demand it would cause serious effects on sales and lower the profitability considerably. This kind of scenario is prevalent in the markets where case company operates from time to time.

5.3 FULFILLMENT OF ORDERS

The last area of vulnerability mapping assesses different scenarios and challenges considering fulfillment of orders. These analyze more specifically company's internal processes (47-63), inter-company related processes (64-77) and the sustainability aspect of supply chain (78-82).

With the assessment of these scenarios the aim is to recognize vulnerability areas regarding the delivery and quality manners of the products. Total of 17 events were analyzed. Most events were evaluated to have very low or small likelihood to happen, however there were found seven occasions that fall in the moderate category of likelihood and three in high likelihood to occur. Also, several occasions are somewhat important to notice considering the consequences that events may result if they take place. Three events stood up in this category by potentially causing detrimental effects to the case company's operations. Figure 6 summarizes the positioning of events regarding challenges of fulfillment of orders.

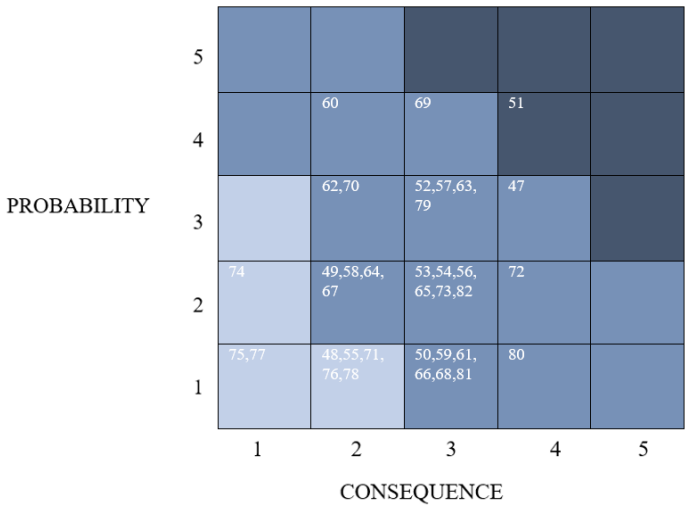

Figure 6. Vulnerability matrix of fulfillment of orders related events (adapted after Zsidisin & Ritchie 2009)

First background questions were asked to create understanding of deliveries, network position and information flow. Information flow of ordering and delivering is communicated mostly via online. The delivery time for case company's purchases is longer in relation to its own delivery time for customers. Supply network has a high level of strategic collaboration when it comes to customers, however the supply network has moderate level of strategic collaboration with suppliers. Collaboration with products is conducted in the middle and at the end of the life cycle of products. Regarding network position, case company reported that there are only a few substitutive customers for the case company. Also, there are only a few substitutive subcontractors.

5.3.1 Company's internal processes

Vulnerability assessment of fulfillment of orders starts with examining different areas of the company's internal processes. These evaluate broadly businesses' processes from different aspects. Mostly these events scored to have mediocre consequences and generally these were unlikely to happen. There were a couple events that are regarded as part of normal operations. It is considered common practice to handle situations of that material acquired in the warehouse has become unusable for the final products. This has scored high likelihood to happen due to the materials' short shelf life. This has only little impact since usually the amount of material becoming unusable is low. Also, some actions can be made to prevent the losses of material if preventive measures are taken fast enough.

A scenario of recruitment of new people was also evaluated. When there is ongoing recruitment, finding motivated and skilled labor is not taken for granted. It is evaluated, that finding the right employees is somewhat difficult. However, accessing skilled labor is not seen as a continuous challenge, so it has only little impact on the case company's operations.

Also, there were a few scenarios which were estimated to occur very rarely and have only little impact. These uncommon events pose only the lowest levels of vulnerability. Reliability and performance of production equipment is not seen as a concern since all production is outsourced to specialized producers who have the needed equipment for effective production. Also, it is unlikely that too wide product range complicates the control of production process.

The company's project management ability is also considered to be at a good level in larger delivery entities. It would be more probable in this case that developing these larger delivery entities creates difficulties to manage the delivery process. This is still considered not likely to happen since case company has experience in creating large delivery entities. Moreover, due to the market characteristics and seasonal demand fluctuations larger entities are created mainly seasonally. These entities usually contain several different products among specific product categories. Naturally, this results more complicated supply process. Therefore, case company highlights the importance of careful organizing and planning. Also, experience of history reflects knowledge of handling supply processes of larger entities, so the effect of this scenario is estimated to remain quite low.

Mostly the effects of challenges regarding company's internal processes were estimated to have intermediate consequences to company's operations. Probabilities for these scenarios to occur fluctuated from very unlikely to fair chance to happen. Three of these scenarios were evaluated to be very unlikely to take place in the case company's internal processes. Firstly, usability challenges of the company's ERP system are considered to have very low probability to occur since the ERP system has been developed for case company's usage. It is also constantly monitored and updated if needed. However, there can be some unexpected difficulties. Naturally, this causes challenges but usually these are temporary and can be fixed with the help of IT services.

Also, difficulties meeting customer quality requirements is not considered a center problem since quality is regularly monitored and continuous work is done to guarantee the highest quality possible for products. This is ensured by close collaboration with suppliers and clear product specifications are provided for each product. Production sites are also visited regularly to assess quality. Case company also has its own monitoring program, which tests different supplier's products regularly.

Furthermore, difficulties concerned deliveries are not regarded to be a result of poor competence of the staff. Case company has trained employees with knowledge of each link in the supply chain. More probable would be a scenario considering a shortage of staff capacity because of growing production volumes. There are regularly ongoing campaigns that may result in an increase in workload for staff in a short view.

Also, there is a small probability that production lead time is too long. This has been evaluated to have mediocre consequences since this may result in cancelled purchase orders. Some customers have timely delivery scheduled and if there is too long production lead time and items are not delivered according to the schedule, they will not be able to transfer the delivery date. There may be restraints of customers take in schedule or then there is no need for the product if the delivery time frame has prolonged.

Furthermore, large variations in the predictability of production lead time may cause some challenges from time to time. In creating larger entities of product, the producer informs a production plan. Yet, it is quite possible that large variations in production time occurs. For example, COVID-19 restrictions have caused delays in production. Also, there may occur sometimes issues with production lines, so it contributes to variance in production lead time.

Also, there is a small probability for repeated unexpected problems and interruptions in production. This is directly linked to the amount of available raw material in the markets. The shortage of prevailing raw materials correlates to production difficulties which most likely affects to prolonged production times and it results in variation to production lead time. In addition, market characteristics create variations to production lead time. Since the case company buys in many cases from their own contract producers, these producers are not obligated to sell their products for specific customers. Products are sold to customers that are offering the best price in the market. These competitive situations may cause fluctuations to predictability of production lead time. This may result in delays to case company's own purchase orders and cause effects to sales if products do not arrive as scheduled. If there occur significant changes in the reliability of production lead time, it will result inaccuracies to predictability of stock levels and consequently to part of the deliveries for customers. As a result, security of supply can be damaged in a short view.

Additionally, there are fair chances for delays in deliveries due to a temporary capacity shortage. It is estimated to have mediocre impacts and quite likely to happen that delays occur in deliveries due to shortage of staff or capacity of equipment. Last year has proven that it is possible that suppliers have these kinds of problems. COVID-19 restrictions have led to suppliers being forced to run production with lower staff capacity. Primarily challenges with production machines and equipment are quite likely to occur. Impacts are also estimated to stay moderate since usually in production facilities there are possibilities to change production lines and equipment. In some cases, even temporary changes to other production sites are possible to prevent further causes of capacity shortages. However, usually these occurrences of capacity shortages are temporary. Therefore, the effect has been evaluated to be moderate and not considerable.

However, internal staff capacity poses a challenge since every staff member has their own responsibilities to take care of. Also, due to company's size company is very dependent on staff capabilities. Therefore, there is also a need to notice a scenario where company's key person will leave the company's service. This has been evaluated to have a fair chance to happen. Since the area of expertise of the case company's staff, it may be hard to replace the silent knowledge of leaving personnel.

There are also a couple events that are evaluated to have some serious consequences to the case company's business. If production would not be planned in a careful manner,

deficiencies in production planning will cause significant problems in meeting deliveries. Consequently, production planning is linked to procurement and inventory management. Procurement from suppliers is done based on the evaluated need of customers. This is based on pre orders and evaluation of the market situation and seasonal figures. Sometimes abrupt fluctuations in demand occurs and supplied amount cannot be adjusted accordingly. Thus, there is loss of potential sales or excess stock. Therefore, deliveries are very much dependent on the planning aspect of procurement. Moreover, very long supply chains for products pose challenges for production planning. It can take up to 12 weeks to attain an aspired product. Therefore, the realization of these plans remains unsure and production planning has a vital role. Case company reports that especially during exceptional times, there is always uncertainty prevailing. After COVID-19 took place, shipping and container traffic has not normalized. Also, restrictions may emerge abruptly to production facilities.

So, there is a high likelihood that inaccuracies in production planning may cause further challenges. If deficiencies occur in production planning, this may lead to shortages in inventory and worst-case scenario there is no inventory at all. Substitute products may be found, but supply process from new suppliers takes time. So, all in all deficiencies in production planning have a great impact on the case company especially if this kind of situation is not handled and responded fast enough. Regarding product sales it would have serious impacts financially. However, it depends greatly what product category is concerned if there would occur challenges due to shortages in production. Products have different values and effects on the whole product group. If production planning of one important product category would be unsuccessful it would have severe consequences and getting back to the normal operations would take time. It would not only have direct financial impact but also indirect consequences. This scenario has consequences especially regarding customer trust. Customer trust may be harmed if the consequences cannot be handled. Customers have especially chosen case company for its supplier, so they may not find replacement products easily. This may have long term impacts since restoring trust requires lots of work. Also, resolving problems necessitates lots of resources which ties resources. Time being used to resolve problems is out of increasing sales and other daily tasks.

Inventory shortages are concerned one of the current challenges that the case company is facing. Inventory shortages prevent delivery from being completed since customers do not place obligatory orders for the future. Case company must therefore balance with products

shelf life and Days-in-stock (DIS). Products have quite short shelf life, so it is important to sell them accordingly to the remaining shelf life. This is explained to be quite a common issue and this scenario has been evaluated to be one of the most likely to happen. This is a consequence of seasonal market trends which are hard to predict in advance. Therefore, it is possible that inventory has shortages in some product categories before more is supplied. As a result of shortages in inventory, deliveries for customers may be only partly delivered. Also, there is a risk that these shortages cause delays and that deliveries are cancelled since there are no products in inventory. This has significant consequences since it contributes direct loss of sales.

5.3.2 Intercompany processes

The vulnerability mapping model then assesses the possible challenges that comprises processes between the case company and other firms in the supply network. For the most part this area was evaluated to contain low consequence events which happen quite rarely. Only a few events were recognized to have some effect and one to have serious impacts on the case company's operations.

There are no difficulties in accessing external services since the service solutions utilized by the case company are quite established. Additionally, the case company do not use complex services in production and there is no high dependency of this kind of outside services. However, software services can be named one of external services that case company is naturally dependent on. Since there are continuous observation and development of this area so that operations are running smoothly, there is no predicted concern on this area. Also, there are no problems detected in the past and it is therefore estimated as very unlikely. If somehow problems occur, such effect would only affect short term and cause some delays to some deliveries if the issue is not fixed before it would affect delivery schedules.

Procurement time being too long is not considered to cause any issues. It is categorized as very unlikely that reliability of deliveries would decrease because of long procurement times. Usually, the procurement times are known, and deliveries for customers can be planned accordingly. More probable is that availability of critical material has not been ensured and the material is not available when needed, but this is still categorized not to have any impact if it happens. There is no significant number of critical materials used in the production process. Moreover, availability of the critical materials needed in production of products are

ensured. Often some solution is found quickly enough in order to have the delivery sent on time. However, if this situation would occur it could influence on reaching delivery times. This could result in both production planning issues and increased customer dissatisfaction.

A situation where information about changes in product requirements is not transmitted online is evaluated to take place very rarely. This scenario is considered to happen very unlikely since product requirements and detailed specifications are clearly informed in contract between the parties. However, if goods would not fulfill product requirements in some way, customers can contact the case company. Therefore, it would have only little impact. Also, info systems are monitored and evaluated so that used systems fulfill the needs of the case company. It has been taken into consideration in strategy that whole product flow should flow easily via systems also.

A possibility of a failing partnership is regarded as something that arises very rarely. Supply strategy is based on partnership model and there is collaboration with strategic suppliers. Likelihood for this scenario is regarded as very low due to the partnership model. Furthermore, the main suppliers are financially stable companies, so it would be very unlikely that they would file for bankruptcy. Collaboration with partners is developed to assure mutual benefit for both parties. This ensures that the case company would be preferred partner if challenging times would occur. Therefore, case company has predominantly one specific supplier for each product category and single sourcing is utilized. Case company has ended up using this operating model through a certain procedure and there are couple reasons for this. Firstly, there are commercial reasons and that operations are continuous. Secondly, case company needs products that are made according to their specifications. This way operations stay in a good level and quality of products are ensured. These reasons necessitate that there are main suppliers. Changing suppliers temporarily would be such a long process that it would not be sensible in case company's prevalent situation to start working with a new supplier from scratch. Case company reports that there has been a change of supplier in history. However, there are some exceptions and not only single sourcing is used. Some products may have different suppliers inside the same corporation. These subsidiaries have separate production plants. However, these are audited by case company and usually used in situations where there are sudden backlogs. Moreover, some product categories have two suppliers in order to attain quality goods around the year.

Furthermore, likelihood regarding a failing partnership with subcontractors is very low. It is considered to have only small effects on the case company's business since the preparation and event readiness is estimated to be at a good level in the supply chain. There are several substitute service-providers, so there are alternatives available if some subcontractors have problems. For example, in this case there are several different haulers and material suppliers.

More probable than the previous scenario would be that customers are tightening the delivery time requirements. However, the probability that these tightening delivery time requirements cannot be met is estimated to remain small. Since usually customers have agreed ordering and delivery schedules, probability for this scenario is somewhat low. Customers also provide their estimates for ordering. However, due to the nature of the business field, need for products can arise on a short notice. This demands a fast response from the case company. Therefore, safety stock is held, and case company has informed timeline for ordering, so that the warehouse is able to collect the items. Hence, there is a small probability that some customer would still need some item. This is only estimated to have small impacts since these are situations that consider so called extra deliveries which are not the main source of income. On the other hand, if the case company can react and place a new order early enough to meet the delivery timeline, it provides extra sales and strengthens the relationship with customer.

A situation where products life cycles are not as planned, is considered to have small probability to happen. While there is a conception of life cycles of every product and estimated shelf life is known beforehand, there may occur exceptions. If the packaging material has been harmed, it impacts the products shelf life directly. Though, normally products follow a certain shelf life, so this has only little impact on sales. Normally quantities of defective items remain low. Also, case company has emphasis on quality products, so products are voluntarily declared to have a shorter shelf life than they actually have, in order to ensure the consistency of the product quality. Also, production must be compatible with the quality requirements. Case company's own suppliers need to meet the expectations concerning life cycles of products. Providing sufficient shelf life of products is important especially to customers of wholesalers. If there would be products which have too short life cycles, these products would be sent back to the supplier or some other solution would be negotiated. This may result in loss of sales margins. Yet, this has is estimated to have only small consequences. Issues regarding products life cycles are difficult to prevent entirely because of the short life cycle of the products. Case company has normally found solutions

for customers for events like this. This emphasizes the importance of good customer service so that these situations do not lower the overall customer satisfaction.

The circumstances where the network is unaware of the usage environment of the end-product is evaluated to be somehow possible. Although, operators are regulated to some extent by law and safety regulations. These regulations need to be followed to ensure safety of end-user usage. While the consuming environment of the products is mostly self- explanatory, the final product can be sold to different customers which have different needs according to their operating environment. There are occasions where case company receives questions about how to best use different products. Consequences for this occasion overall are small since case company's employees can give professional advice and add value to the product by advising the customer.

Next cases are categorized to have already some effects on operations. A scenario of incompatible business-to-business information systems which would cause errors and delays in deliveries is assessed to have moderate effects since case company is relying on info systems in ordering to some extent. Nevertheless, it depends on the size of the customers business if there are joint information systems. With main clients there are well established and developed info systems. Moreover, these systems are closely monitored during the day to ensure the reliability of daily deliveries. So, a situation of deliveries being delayed or erroneous since there are incompatible B2B information systems, would be very unlikely. It is estimated to have a very low probability to occur. If there would be a problem with these systems, most likely this problem would be noticed, and other channels of information exchange would be used. On the other hand, if the problem would not be noticed early enough it may cause some delays and lead to some degree of dissatisfaction amongst the customers' side. Also, it could cause short term problems considering extra inventory.

According to the evaluation of the case company, a situation considering a potential risk of not detecting significant quality problems before delivery to an end client, is very unlikely to happen. Current production and testing methods are well established, and products can be evaluated before delivery to the end customers. Case company's warehouse has a responsibility to make sure received products are in the right condition to sell forward to the customers. Overall, not detecting substantial quality issues would have moderate consequences. If products quality is not as agreed with suppliers, products can be claimed in some cases and sent back to supplier. However, transportation costs realize and there may be

other monetary losses such as loss of potential sales. However, there is always a chance that in the process of logistics something unexpected happens, and the products may be harmed. Therefore, customers can inform the case company if there occur quality problems. Case company has established an easy process for claims if quality problems occur. If quality problems would occur frequently this can have harmful effects to the brand image in the long view and weaken the case company's market position as the market area is highly competitive.

There is a small likelihood for problems occurring due to inaccuracies in forecasts in the network. Forecasts may be inaccurate due to the demand fluctuations in the market. Demand is seasonal, so quite accurate forecasts can be made with the help of monthly sales analysis. However, fluctuations may occur and accurate forecasts about the future are timely difficult to make. Orders are placed in a timely manner for suppliers and safety stock is evaluated every time orders are placed to suppliers in order to buffer against some fluctuations in demand. Yet, if sales forecast is too high, there may be unnecessarily large amount of goods supplied and if demand would weaken unexpectedly, it would contribute to insufficiency in inventory turnover and cause extra inventory. Furthermore, since most of the products have a short life cycle, these would be needed to sell with reduced price for specific customers. Also, since the supplied amounts of some product categories are planned according to expected sales and months ahead, the actual amount of demand is only estimation and demand can fluctuate by the time that sales take place. Therefore, this kind of scenario would be considered to have decent consequences for the sales and inventory levels.

There is a great possibility that customer's product specifications may cause some challenges. The accuracy of customer product specifications is varying regarding the customers. Usually the need is identified, however the specifications for the products are in many cases inaccurate. So, there is a great possibility that customer specification is not clearly represented. Especially when sales are asking an offer request and mapping customer need, customer specifications are inaccurate. The need is then mapped out more carefully and usually it clarifies during the process of finding suitable products. Salespeople have the responsibility to ask and request product specifications which are specific enough. When customers' product specifications are not correctly informed, there is a risk that the product is not suitable for end customers use and the wrong type of product is sold. In these cases, it is important for the case company to have accurate documentation of this process. If there is

a customer specific product, it is tested and approved by the customer so this risk can be lowered.

Only one scenario of intercompany related challenges was recognized to have serious consequences. This scenario considers problems with company's own subcontractors delivery reliability. The effects would be crucial to the performance of the case company since specific subcontractors such as logistic partners are in key role in transportation of goods, both for the case company and to the customers. In other words, there is high dependency on single subcontractors. Nonetheless, delays of subcontractors may have some serious impact since this directly contributes the company's ability to fulfill orders to customers. Challenges with delivery reliability would result delays to case company's deliveries. In the worst-case scenario purchase orders would be cancelled. In the short term this influences the company's cash flow since sales can be lost if key subcontractors are not able to deliver the goods on schedule. Case company aims to keep safety stock on a good level to be still able to respond to customers demand, if some problem would occur with own subcontractors. Case company's customers value good security of supply. So, increased client dissatisfaction may compromise customer loyalty in the long run.

The danger of bottlenecks in the supply of products is high and case company is fully aware of this vulnerability area in its supply chain. Thus, close collaboration with clearly defined business relations both product suppliers and customers are maintained. Suppliers are very carefully selected and continuous quality inspections in the plants are made to assure that both case company's and customers' requirements are followed closely. Each step from production to case company's delivery to customers are documented carefully. More specifically, purchases from the key suppliers are communicated regularly so suppliers can deliver desired amounts of goods on time. Generally, the delivery time of the company's own subcontractors is not considered to cause problems. Case company has been able to settle sufficient delivery times with their key suppliers. The delivery time is known for each subcontractor and case company can estimate the arrival date and delivery date to the customers. Therefore, case company has necessary time window for production lead times to fulfill agreed delivery times with the customers. Thus, the estimate of occurrence for this kind of scenario is considered low. Challenges related bottlenecks in the supply of products that impact on delivery times occur seldomly.

5.3.3 Sustainability related aspects

The last area examinates the sustainability aspect of the supply chain. The examination of sustainability view reflects case company's possible vulnerability areas rising from the different areas of environmental, social, and economic responsibilities. The case company is fully aware of the importance of sustainability aspect and evaluates that sustainability of the supply chain has some influence on the brand. There were no major concerns in this area. Case company invests clearly more in sustainable solutions than the industry average, in order to meet both customer requirements and expectations of end users.

It is highly unlikely that customers' expectations regarding responsibility of sustainability cannot be met. Case company's aspiration is to ensure that products are a sustainable choice. Also, it is very unlikely that the purchased product does not meet the principles of sustainable actions. Both scenarios could potentially affect sales since sustainability is more and more a rising concern of society. Consequently, case company invests in the traceability of their products. This activity is based on EU legislation, which imposes requirements on both importers and producers. Whole product flow from producers to retailers and end users is carefully tracked. Thus, case company has further added control criteria to ensure as good and reliable products as possible.

However, the origin of the product may cause challenges for the sales. Customers are very aware of sustainability matters and domestic products may be preferred to reduce carbon emissions. Therefore, customers may choose some other company for their supplier over the case company. Also, some customers might not order specific products due to the origin of the product. Therefore, case company evaluates production countries carefully and product origin plays a vital role when selecting production country. Also, key environmental impacts commonly associated in case company's industry have been identified and addressed.

If case company's suppliers do not meet the requirements for sustainability it would have detrimental consequences to the case company's sales. Consequently, case company would not be a preferred or selected partner if their own suppliers have sustainability issues. Therefore, all three key areas of responsibility: social, economic, and environmental are carefully evaluated by the case company's view and key operations and measures are defined to achieve sustainable business. Case company also monitors CRS policies and the

achievement of CRS related goals. Hence, a risk for the scenario to not meet the requirements for sustainability is very low.

6 EMPIRICAL FINDINGS: SUPPLIER PERFORMANCE

Second part of the empirical research focuses to analyze customer experiences of supply chain performance on prevailing markets. Previous research indicates that customer orientation is linked to higher risk management performance in the supply chain (Hallikas & Lintukangas 2016). The knowledge of prevailing challenges in supply chain enables to design a supply chain structure in a way that reflects to readiness and improve better supply chain design decision making (Wagner & Bode 2006). Furthermore, research emphasizes that, resilience can be improved by learning from experiences (Rice & Canioato 2003). Effect of disruptions can be decreased by utilizing the knowledge from previous disruptions (Jüttner & Maklan 2011). Consequently, the aim of analyzing supplier performance is to detect possible sources of disruptions and other factors that may affect to customer satisfaction linked to supplier performance. Previous research suggests also that organizational capability to learn from practice should be shared collectively. Developing such organizational learning mechanisms facilitates a firm become a resilient organization (Nonaka & Toyama 2007). So, these aspects are further analyzed in order to utilize gained knowledge of prevailing customers when entering new market areas with the concept. Observation of the current market and supply chain is conducted to assist with the entry for new markets. The data of empirical part of supplier performance is conducted by survey which evaluates supplier performance from different aspects of perceived quality of products and experiences of fulfillment of orders. Total of 18 customers responded to this survey.

Net promoter score was chosen for evaluating supplier performance since it has been proven to demonstrate future growth most effectively. As previous studies indicate customer loyalty has been shown to be one of the most significant drivers of companies' growth. (Reichheld 2003) Also, since there are other factors which drive a company's growth, in addition to customer loyalty (Reichheld 2003), other customer satisfaction indicators were chosen to evaluate supplier performance more extensively. These quality and order fulfillment measures were selected in order to further detect performance areas where the supplier may have a need

for future improvements based on current customer expectations. Customers were asked to rate the importance of multiple different quality and order fulfillment aspects on a scale of 1-5 so, that it could be observed how important part these aspects are for supplier performance according to customer's perspective. Followed by this evaluation, customers were asked how the supplier has performed in these areas also on a scale of 1-5. This way future development target can be noticed and taken into account when entering new markets.

6.1 Net promoter score

Since one significant part the evaluation of the supplier performance and growth according to previous research, is assessing the customer's willingness to recommend supplier for other customers. As customers not only demonstrate that they have obtained good economic value from a supplier, they also place their own reputations on the line, making the willingness to recommend a strong indicator of growth. Only when customers show strong loyalty, they are ready to risk their reputation. (Reichheld 2003)

Therefore, customers were asked how likely they would recommend this supplier for other stores. As a result, net-promoter score was calculated for the supplier which indicates proportion of customer's who are divided into "promoters" and "detractors". (Reichheld 2003) This estimation was conducted by using scale of 0-10. Based on responses on rating scale, responders were divided into groups recommended by Reichheld (2003). Customers who responded 9 or 10 were categorized as "promoters". The customers who gave rating of 7-8 were grouped to "passively satisfied". The remaining group of customers who rated the likelihood for them to recommend the supplier as 0-6 were considered as "detractors". As a result, there was total of 39% were promoters, 50% passively satisfied 11% were categorized as detractors. Therefore, when the percentage of detractors was subtracted from the percentage of promoters, the net promoter score for the supplier is 28%. As a reference, according to research conducted in more than 400 companies in 28 industries the median net-promoter score was 16% and the best performing receive around 75 % and up to over 80% of net promoter score.

Previous research indicates that, in most industries, there is a strong correlation between a company's growth rate and the percentage of its customers who are categorized as "promoters". Therefore, the more there are customers that are in the "promoters" category, the more the company has growth. Furthermore, the net-promoter score can be used to gain

useful information of how to increase the number of promoters and decrease detractors. The measurement of net-promoter score should be followed by comparison to groups such as other customer segments and regions scores and especially to direct competitors. Usually this enables to identify the reasons of differences in net promoter scores. After the estimation of the causes of differences, best practices can be implemented. (Reichheld 2003)

The supplier overall performance was also evaluated more broadly. According to the customers over half of them (56%) thought that supplier has performed well, and they reported being quite satisfied. One third (33%) perceived that the supplier has been presenting very well and reported being very satisfied with supplier's performance to this date. Remaining customers (11%) had a neutral opinion about the supplier's overall performance and they reported being neither satisfied nor unsatisfied. There were no answers that indicated that customers would be somehow unsatisfied with supplier's overall performance. Figure 7 demonstrates the ratio of answers given by customers.

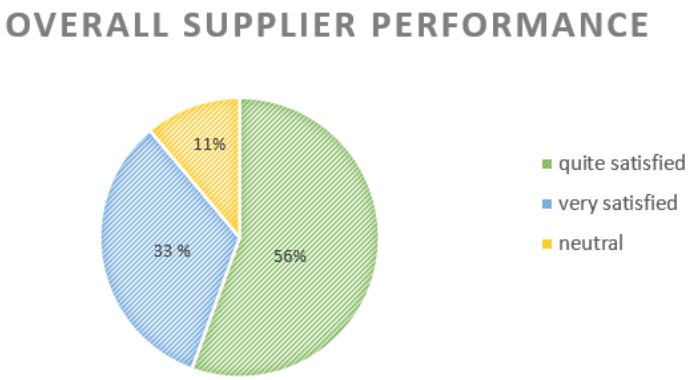

Figure 7. Overall supplier performance

In order to evaluate overall supplier performance, the importance of supplier's customer service was mapped out. The evaluation regarded the accessibility of customer service and more specifically customers were asked how much they value the opportunity to contact customer service and easily get in touch with representatives of the supplier. Considerable majority of customers (67%) rated the accessibility of customer service as very important feature for supplier's overall presentation. Also, 22% rated it as important. 11% considered accessibility as quite important for them.

Also, the customer satisfaction about accessibility to customer service was surveyed. Half of the customers (50%) were very satisfied with the opportunity to get in touch to customer

service and 33% were also satisfied. Remaining 17% of customers described being quite satisfied to the supplier's accessibility of customer service. Customer service preferences were also mapped out. Customers were asked to give examples of what they think that are particularly important aspects regarding supplier's customer service. Most of the respondents highlighted the importance of responsiveness and quick responds and reactions were emphasized. Moreover, the availability of customer service was given priority and the fact that customer service is easy to contact.

Customers emphasized the importance of being able to get in contact so that help could be offered in case of issues regarding deliveries. Correct information and clear communication in all communication forums was also mentioned. Other characteristic of customer service that is expected by the customers was to be solution oriented. This considers the knowledge of the field and the ability to develop solutions. Especially flexibility and open-minded perspective to find solutions around the quality related issues and to be prepared to make a credit in case of error were brought up by customers.

6.2 Quality

A set of quality related questions about products were asked and customers evaluated these on a scale of 1-5. Overall quality of products compared to similar products in the same product category was perceived by majority of customer (44%) as better. Second group thought that products are little better in terms of quality (28%). Third group had categorized concepts products as much better than substitutive products among the same product category (17%). Only minority reported that there is no difference in quality compared to other products in the same market when evaluating the product ranges quality. Figure 8 visulizes the distribution of customers answers.

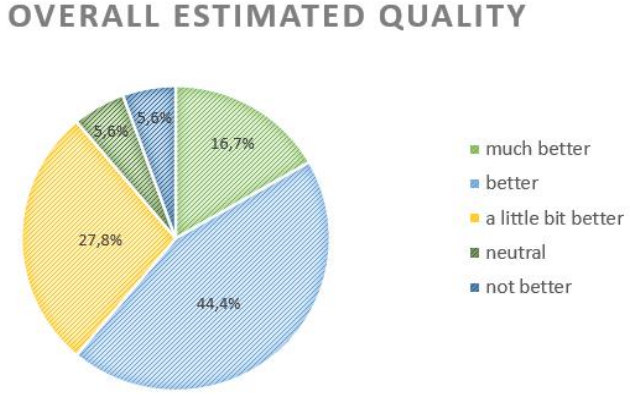

Figure 8. Overall estimated quality of products

Especially the quality of products was given good feedback from customers. According to the study the concept is seen as a brand that stands for quality. Also, the variety of product range and design were given credit for. Moreover, product range was seen as value creating and innovative/unique in its market. The concept is smartly directed to specific segment which values high quality goods. Also, it was noted that specific details have been utilized that other supplier do not have to offer for customers.

Customers were asked to evaluate a variety of product related quality factors. Product design, sustainability of packaging, shelf life, turnover rate and origin of the products were assessed. Customer were asked to evaluate how important they think product's attractive packaging design is. Results showed that customers regarded product design as a significant quality factor. Majority (83%) had responded that it is very important factor. The rest of the customers also categorized this factor to be important. Customers were also asked how satisfied they have been in concepts present product design. Customers were mostly pleased with product design and gave positive comments about it. A great majority reported to be very satisfied (39%) or satisfied (33%) with product design. The rest were still quite satisfied (28%).

Also, the sustainability aspect was evaluated and customers were asked how much they value the fact that the packaging of products can be recycled. According to replies, differences were found of the opinion regarding the importance of packaging sustainability. 33% see it as important and 28% that it is very important that the packaging can be recycled by the end user. Also, 17% of respondents saw that it is quite important charachteristic of packaging. However, there was customers who regarded sustainability of packaging as less important and 17% replied that it is only little important and 5% that it is not important. When evaluating the satisfaction of end users possibilities to recycle supplier’s products, there was a clear emphasis on replies that indicated customers being very satisfied (44%). Second most answers were given to satisfied category (28%). There was a few customers (22%) that reported being quite satisfied. There was also one reply (5%) that indicated that customer is not happy with the current possibilities for end users to recycle the products after usage.

As a part of concepts product ranges quality factors, products shelf life was evaluated. Product range has a selection of different type of products which have a variety of different shelf life. All the customers thought that remaining shelf life is a very important factor of quality. 94% of customers categorized this as very important and only one as important. Also, the customer satisfaction of products remaining shelf life was evaluated. Mainly customers were satisfied

(44%) and quite satisfied (33%) with delivered shelf life for products. Variation occurred in this question's replies and there were also customers who reported to be very satisfied (11,5%) with products shelf life and, on the other hand there was customers who were not satisfied (11,5%).

When customers were asked if there has been occurring some challenges with products, they reported a few product related factors that are currently posing further challenges to sell products forward. Shelf life of products was one of these three main factors that are posing challenges for customers. Customers reported that supplier has delivered occasionally products with a quite short remaining shelf life. Since products have a limited amount of remaining shelf life dates after arriving at the store, customers reported this to cause further challenges for them due to the short time to sell these products forward. Consequently, of a short period of time to sell these products, the products may expire and there are products remaining. These remaining products which cannot be sold anymore may cause further inconveniences for the customer to get rid of them and weaken customers profitability.

Turnover rate for products was assessed by asking how important the customers think that turnover rate of these types of products is. This estimation considered the time that customers receive the product in warehouse until it leaves the checkout. Over half of customers (56%) considered that the turnover rate is an important indicator for these kinds of products. Also, 33% saw it as very significant number to follow. Only 11% of customers regarded that products turnover rate is quite important factor. Generally, products turnover rate is perceived as important for these kinds of products since it is directly connected to the products shelf life. Thus, if delivered goods have too short shelf life remaining, there is only limited period of time to sell these products and it weakens the turnover rate of products. Some customers reported that there has been a challenge with the turnover rate when delivered goods have too short remaining shelf life. Also, some reported that there has been challenges to direct customers over products and get them to stop and buy the product in order to get the rotational speed and that way profitability for the products. Customers satisfaction level about product ranges turnover rate during the time they have sold the goods was also evaluated. Replies indicate that over half of the customers (55%) have been quite satisfied with the turnover rate of the products. The second most answers (28%) were given to "not satisfied" category. Remaining (17 %) customers were satisfied with the products current turnover rate.

Origin of the product was also evaluated. According to the questionnaire, replies were mainly categorizing the origin of products as quite important (33%) for the customers. Second largest group of customers thought that it is quite important (22%) for them. There were also customers that considered products origin as insignificant or just a little important for them. Also, there were customers that regraded the origin as a considerable factor for them. Some customers pointed out that origin plays an important role because there are end users in the customer segments that prefer and demand domestic products. There have been some challenges for customers due to the origin of products. However, when customers were asked to evaluate the satisfaction of chosen origin for the products, mainly customers were pleased with the chosen origin for the products and nearly half (44%) of responders were satisfied with the origin. 22 % were very satisfied with the chosen origin of products and 28% of customers reported to be quite satisfied. Only minority was not contended with the origin of products.

When customers were asked if there has been occurring some challenges with products, some customers reported that the origin of products may cause challenges to sell these products forward. One customer pointed out that in the customer segment of end users there are people who prefer and demand domestic products over imported goods. Some cases have occurred in which end users have come back with the product since they have supposed it is a domestic product. However, this customer was ensured that if there would be a way to pursue the people to try this product, the quality would override this problem and they would buy the product again.

6.3 Fulfillment of orders

A set of questions were asked regarding fulfillment of orders. Customers were asked to evaluate the importance of different areas of supplier performance regarding order processes and deliveries. This evaluation considered stock availability, ordering process, delivery reliability and flexibility and logistics. After that they were asked to analyze how the supplier has performed in these areas.

As a part of order fulfillment customers were asked how important they think that there are always enough products available in stock to order. Product availability was seen as a significant factor and over half of customers categorized it as very important. 40 % were also categorizing it as an important factor. Only one answered that it is quite important factor for

them as a part of supplier performance. Customers were then asked to assess how the product availability has realized in practice. The answers were distributed to satisfied (28%), quite satisfied (28%) and not satisfied (28%). There were only a couple customers who were very pleased with product availability and one that was not satisfied at all. Thus, customers have differing opinions about the supplier's ability to have available products in stock.

Additionally, when customers reported a few factors that are currently posing further challenges to sell products forward, one of these was product availability. Customers pointed out that there have been some challenges with the availability of the products. They reported that they have not been able to attain some products. These availability challenges have been linked to occur especially during high seasons which have high demand for specific products for limited amount of time. There have been cases where customers were given a substitutive product to replace missing product for high season, the customer reports that this has created doubts about the quality of the product. Moreover, the shortage of few items in the delivery entity further causes challenges to attain these products due to shipping costs. When delivery is missing only one or few items due to supplier's shortage of items, it is costly for customer to pay shipping for these items.

As a part of supplier's evaluation of fulfillment of orders, the order process was estimated. An opinion on how important it is to provide a simple ordering process of products was asked. According to the replies a great majority of customers thought that is a substantial part of fulfillment of orders to have a simple ordering process and categorized this as a very important factor. Additionally, 17% thought that it is important and remaining 5% that it is quite important. Furthermore, as a part supplier's services effortless ordering was mentioned.

Opinion of suppliers current ordering process through current system was also evaluated. Majority (61%) were very satisfied with current system. 17% were satisfied and 22% quite satisfied. On the other hand, when customers were asked if they have experienced some challenges in the collaboration with supplier, orders via the ordering system was mentioned. One customer reported there has been challenges to reach stop time for orders. There has been also some unclarity of changing stop time for orders. In contrast to this experience, one customer gave positive feedback about the easiness of ordering.

Deliveries and logistic solution provided by the supplier were also evaluated by customers perspective. Focus was on the evaluation of reliability and flexibility of deliveries. Reliability

of deliveries consist the accuracy of delivered orders and the fact that how delivery quantities matches the order placed and the order arrives on time. According to half of the customers, reliability of deliveries is categorized as very important factor. Also, 33% determine that is important and minority of responds were seen reliability of deliveries as quite important for them. Overall, delivery reliability is seen as a considerable part of supplier performance. Customers were also asked to rate suppliers delivery security, and the results indicate that over half of the customers that replied to the questionnaire were satisfied with the delivery reliability. The second largest group of responds were given to opinion of quite satisfied. A couple customers reported to be very happy with deliveries accuracy and only one responder was not satisfied with deliveries reliability.

As a part of delivery reliability the timely delivery was estimated in order to further assess functionality and performance of logistics. Nearly all of the answers classified timely deliveries as very important and there was a clear concensus of the importance of suppliers ability to deliver on time. The replies divided followingly: 78% tought is a very important for them and 17 % see this as an important factor and only 5% as quite important. Also customers reported that they appreciate as a part of suppliers services especially the timely delivers.

Next the level of customer satisfaction on the ability to deliver on time was assessed. Considerable majority of customers were satisfied (50%) and very satisfied (39%) on the supplier's ability to deliver by the schedule. Remaining 11% of answers indicates that these few customers are still quite satisfied with the supplier's capacity to deliver by agreed schedule. None of the customers replied that there has been challenges due to this factor.

As a characteristic of ordering and delivery process, the flexibility and the supplier's ability to make changes if disruptions or some problems occurred was examined. In line with customers repliers, they appreciated the characteristic of flexibility if something goes unexpectedly, since 44% replied this being important and 39% as very important. The rest of the customers (17%) perceived flexibility as quite important. Flexibility of supplier was experienced to be in a quite good level, as reported by most of the customers (56%). Also, 33% were satisfied and the remaining 11% were very pleased with supplier's flexibility when it comes to making changes in orders and deliveries. So, there has not occurred substantial challenges in this area of supplier performance as stated in questionnaire.

The supplier is providing a logistics solution for the concept's products. The customers were asked how they value the importance of the type of logistics solution that suppliers offer currently. This question divided customer into two main groups, the first group (44%) of respondents thought that it is very significant that supplier provides a logistic solution, and the other group (39%) of respondents valued the logistics provided as quite important service. The rest of responds (17%) were categorizing this as an important factor of the service of supplier. Distribution of repliers indicate that logistics provided is seen as a significant factor, however there is a part of customer base who does not value logistics provided as top priority for them.

They were also asked to evaluate how satisfied they have been with the current logistics solution. Overall, the customers were satisfied with current logistics solution provided by the supplier. Half of the customers reported being satisfied and 28 % were very satisfied. Only 17 % of responds indicated that customers were quite satisfied and remaining 5 % not satisfied.

According to the result, majority of customers haven't had problems with deliveries. However, in order to identify experiences of possible disturbances, customers were asked if there have been any events, which they have been experienced as disturbing. Regarding ordering and delivering there has been only few challenges. Disruptive events of supply chain were reported to consider quality issues or shortage of goods. Quality issues have been generally related to damaged packaging. Moreover, supply of the products has always not been in expected level since, according to the questionnaire there were reported shortage of goods as a disruptive event.

Customers preferences were asked on how to handle these kinds of challenges. Contact and communication with supplier were most frequently brought up. Responding to difficulties and compensating these challenges in some way were mentioned also by several customers. One suggestion was to keep a base assortment for specific products so that there would be sufficient availability of products in stock. It was reported to create difficulties for the customer to sell the goods forward if there are no basic products available.

However, customers that had faced issues regarding deliveries reported that that they were quite satisfied with the way these events were handled. They gave feedback that these issues have been handled overall well and some reported that good solutions were found to resolve

these. Customers did not have any opinion on preventive measures which could be taken to prevent delivery problems. Customers may see preventive measures as not relevant procedure for them. If some disruption happens, these can be handled via contacting supplier as they have reported earlier.

7 DISCUSSION & CONCLUSIONS

The increasingly unstable business environment and sensitive supply chains have risen the need to re-evaluate current state of supply chains (Christopher & Holweg 2011). Firms have begun to view supply chain disruptions more critically and to reconsider their supply chain strategy and design because some companies recover from unexpected events better than others (Scholten et al. 2019; Wagner & Bode 2008). Previous literature provides strong evidence that implementing resilience in the supply chain systems enables supply chains both cope with uncertainty and develop competitive advantage (Pettit et al. 2010).

The main research question examined ways to design a resilient supply chain when entering new markets. Therefore, firstly, the main features of resilient supply chain were identified in order to create a comprehensive understanding of resilience capabilities. Three main characteristics were found. These are recommended to utilize as a part of case company's supply chain strategy. Research indicates that main capabilities linked to resilience in supply chains is the capacity to retain functions, flexibility, and adaptive capabilities of a supply chain. One of the key features of resilient supply chain is capability to retain operational capabilities. It reflects the amount of change that can be tolerated while retaining the same controls levels on a structure. (Carpenter et al. 2001) Flexibility of a supply chain reflects the ability to return to original state after disruptive event (Peck 2005). Moreover, it is the ability is able to coordinate itself effectively and without force from external factors (Carpenter et al. 2001). So, it enables to adjust to both positive and negative effects of the environment (Ponomarov & Holcomb 2009). Therefore, since flexibility capabilities correlate positively to the responsiveness of a supply chain, this capability also improves the competitive position of a firm (Sheffi & Rice 2005). According the literature, flexibility capabilities are closely linked to adaptive capability. When a supply chain has adaptive capability, it is able to create

the response to a disruption and therefore it enables to adjust to new market positions. (Carpenter et al. 2001)

Secondly, in order to answer the main research question, the ways how resilience can be developed into supply chains were examined. Primarily, previous literature highlighted especilally the importance of strategic desing (Sheffi & Rice 2005). Resilience should be designed into a supply chain as a part of firm's strategy. Companies that can create strategic options and adjust its resources faster than its competitors have substantial advantage. (Hamel & Välikangas 2003) Even though there is no one specific method for building supply chain resilience, research has proven that specific elements can improve the level of resilience in a supply chain (Christopher & Peck 2004; Hamel & Välikangas 2003). Four key principles for creating resilience into supply chain were found. These were: supply chain re-engineering, developing flexibility, enhancing the level of supply chain collaboration and creating a supply chain risk management culture to the organization. Furthermore, research shows that there are multiple different capabilites of a supply chain which contribute imporved level of resilience (Christopher & Peck 2004; Pettit et al. 2010)

However, the priority of areas of resilience capabilities should be further investigated, so that improved performance and balanced resilience capabilities would be achieved. Research further suggests that supply chain structure and resilience capabilities should be created to match a firm's own vulnerability areas. (Pettit et al. 2010; Ponomarov & Holcomb 2009; Scholten et al. 2014) Therefore, the main areas that are posing vulnerability for the case company were classified. Third sub-question analyzed the main areas which are currently posing vulnerability for the case company's supply chain. Main challenges were identified with vulnerability matrix by prioritizing the areas that may cause sources of vulnerabilities. As a result, main vulnerability areas of demand related, cost management and process of fulfillment of orders were identified.

First part of vulnerability mapping concentrates to evaluate demand related uncertainty areas. Three priority events that are posing vulnerability for the case company's supply chain were found. Demand related vulnerability areas are linked to customers inaccurate demand forecasts, customers trust to delivery reliability and shortages of supply network capacity. All of these are linked to case company's delivery reliability. All in all, case company is quite dependent on important customers and main suppliers' capacity to deliver ordered goods. Therefore, building collaborative relationships across the whole supply chain is

recommended. Collaboration has been proven to improve the level of resilience (see Hallikas & Lintukangas 2016; Kim & Lee 2010; Rice & Canioato 2003; Sheffi & Rice 2005; Stevenson & Spring 2007). Enhancing the level of supply chain collaboration with both suppliers and customers is recommended to make supply chain more flexible and improve case company's delivery reliability. As a result of collaboration with suitable partners within the supply chain, information sharing starting from the early stage of the supply chain operations would ensure the exchange of information and therefore reduce uncertainties and complexities (Christopher & Peck 2004; Gunasekaran et al. 2015; Hendricks & Singhal 2005). Cooperation with customers would also enable the planning of more accurate forecasts and gain trust among customers. Therefore, customer relationships are in center role to work with possible issues considering case company's delivery capacity.

Also, supply network is playing an important role since when there is capacity problem in the network, this is having a great impact on the case company's stock levels and capacity to deliver. A deep relationship and collaboration are necessary when there is a great dependency on single suppliers (Sheffi & Rice 2005) and therefore recommended also for the case company. Furthermore, coordinating allows to utilize manufacturers capabilities to detect market trends. As a result, they provide valuable knowledge (Yan et al. 2015). This would support the case company to adapt market changes.

The second part of evaluating case company's supply chain focuses to evaluate possible areas of vulnerability arising from price and cost management related events. According the results, especially, product pricing related events pose uncertainty for the case company. Three priority events were found. These were strongly linked to market characteristics of the field that case company is operating.

Firstly, market price has a great influence on the profitability and the position of the case company. In addition, some customers may have a great power over the price of the products. Therefore, there is dependency on major customers and price level of markets. Furthermore, company reported having collaboration with customers to lower costs to some extent. Thus, since results indicate that difficult predictability of demand causes additional costs for the case company, it would be beneficial for the case company to enhance the level of collaboration with its partners also in order to lower costs. Since deficient information sharing is a significant source of uncertainty and costs in supply networks (Hallikas et al. 2002) literature highlights that improved level of collaboration contribute more sufficient

information sharing. Therefore, both uncertainty and costs could be reduced (Christopher & Peck 2004). Working in collaboration with customers would therefore support providing more accurate predictions of case company's market demand. Also, since some customers have a strong negotiation power over prices, the improving the level of collaboration is recommended since research points out that it is essential to develop deeper relationships with customers in the development of resilient network (Rice & Canioato 2003). Moreover, since there is dependency on some customers, opportunistic behavior can be reduced by having common planning procedures (Hallikas et al. 2002).

The last part of the evaluation of case company's supply chain vulnerability areas considered process of fulfillment of orders. Total of three priority areas were found, one of the areas scoring high strategic importance. The event which is currently posing the most vulnerability to the supply chain considers shortage of stock which prevents the fulfillment of orders for customers. Firstly, literature highlights the importance of the assessment of vulnerability drivers in a supply chain management context. Hedges can be then developed against these according to the gained knowledge. (Christopher & Holweg 2011) Therefore, case company should especially analyze the possible reasons behind stock shortages in order to prevent them in the future. Since challenges related to inventory management and shortage of goods is linked to fluctuating market demand and incapability to respond quickly enough for these changes, research emphasizes the importance of developing adaptable supply chain structures. Especially, creating structural flexibility is recommended for the case company. It enables the adaptation structurally accordingly to demand. Therefore, supply chain structure is able to cope with demand-driven uncertainty by enabling fast responding strategies, such as adjusting prices or availability of products by having multiple factories according to demand. (Christopher & Holweg 2011) Additionally, fast responses to demand fluctuations facilitates gaining market share (Sheffi & Rice 2005). Consequently, it is necessary to re-engineer the supply chain by implementing supply chain design principles and supply base strategy which includes the resilience framework (Christopher & Peck 2004; Hamel & Välikangas 2003). The supply chain design has a vital role in determining how easily supply chain can adjust to new circumstances (Stevenson & Spring 2007; Hamel & Välikangas 2003).

Considering developing resilience in the area of inventory management in order to prevent insufficient amount of stock, the importance of creating redundancy was emphasized by earlier research. Optional resources are needed to buffer against disruptions. (Sheffi 2008;

Rice & Canioato 2003) Inventory management, production line maintenance, material procurement contracts such as purchasing capacity and dedicated transportation solutions are all important aspects of creating redundancy (Rice & Canioato 2003). In general, methods such as holding safety stock and using multiple suppliers are popular (Sheffi & Rice 2005; Sheffi 2008). While investing in flexibility and redundancy may be more expensive strategic option, it offers the opportunity to mitigate the impact of disruptions (Hendricks & Singhal 2005). Ultimately, it is suggested that case company would use a combination of these flexibility and redundancy alternatives.

In addition, previous research suggests that processes to identify and monitor risks should be deployed to complement flexibility practices (Brusset & Teller 2017). Research suggests that resilience can be significantly increased by improving a company's capability to detect and therefore also respond disruptions quickly (Sheffi 2015). The implementation of control and detection systems is considered an essential part of building resilience since it supports the mitigation of supply chain disruption effects (Brusset & Teller 2017; Sheffi 2008; 2015). Sensitive control systems can even detect a disruption before its affect is noticeable (Sheffi & Rice 2005). Improved supply chain visibility improves event readiness because it allows for the identification of sources of supply chain uncertainty (Van der Vorst & Beulens 2002). Therefore, it is recommended for the case company to evaluate the need of detection system. Also, implementing a detection system is suggested to support preventing stock shortages.

Furthermore, since shortages of stock are straightly linked to production planning, providing resilience in this area is also necessary. While production planning effects to the capacity to deliver goods for customers, there is dependency on production capabilities and responsiveness of supply chain. Therefore, literature suggest that, companies should not only control their own operations but also manage the work of their subcontractors (Hallikas et al. 2004). Also, due to the increased use of vertical integration strategies, supplier monitoring is necessary (Sheffi 2015). Furthermore, improving the level of supply chain collaboration is recommended in order to create resilience to production planning and responding to changing customer needs. Improving the collaborative relationships with suppliers and customers is seen as a center part of the creation of a more secure and resilient network (Rice & Canioato 2003) since collaboration has proven to have a strong correlation to supply risk performance and supply chain responsiveness (Hallikas & Lintukangas 2016; Kim & Lee 2010). Collaboration also allows to utilize manufacturers capabilities to detect market trends (Yan et

al. 2015). This would support the case company to adapt production planning to changing customer demand. Also, improved information changing would mitigate uncertainty arising from inaccurate information exchange with case company's customers since one significant vulnerability driver was concerning incorrect customer's product specifications.

Second part of the empirical research assessed supply chain performance in the perspective of current customers on prevailing markets. The aim was to find out if there are existing challenges with prevailing markets by customers' perspective. Previous research shows that customer orientation is connected to higher risk management performance in the supply chain (Hallikas & Lintukangas 2016). Moreover, it is important to consider framework for defining vulnerability and prioritizing risks, when setting a target to build resilience in companies (Sheffi 2008). Knowledge from the previous disruptions can be utilized to support implementing tools to decrease the effect of disruptions (Jüttner & Maklan 2011; Wagner & Bode 2006). So, the knowledge of prevailing challenges in the case company's supply chain context enables to design a supply chain structure in a way that reflects readiness. Furthermore, research emphasizes that, resilience can be improved by learning from experiences (Rice & Canioato 2003). Developing organizational learning mechanisms and learning from practice facilitates a firm become a resilient organization (Nonaka & Toyama 2007). Consequently, supplier performance was evaluated to detect possible sources of disruptions and other factors that may affect to customer satisfaction linked to supplier performance. Also, main areas of supplier performance were analyzed to utilize gained knowledge of current customers' experiences when entering new market areas with the concept.

A set of quality and fulfillment of orders related questions were asked to detect possible disruptive events which may cause challenges for supplier performance. These were assessed in order to create resilience to the supply chain of the case company when entering new markets. Also, supplier performance areas which customers value the most as a part of the service were identified. Disruptive events of supply chain were reported to consider quality issues or shortage of goods. Also, according to the results three main factors that are currently posing challenges for the customers to sell products forward were found. These were products' remaining shelf life, turnover rate, and availability of products.

According to the results there were a few quality related product characteristics which customers valued the most. Firstly, the results indicate that remaining shelf life is a very

important factor of quality for the customers. Customer satisfaction was on a quite good level; however, challenges of too short shelf life were reported. Also, good turnover rate was categorized as an important factor for products. There have been some challenges due to the turnover rate according the results. Insufficient turnover rate is strongly linked to remaining shelf life of products. Products which are delivered with too short remaining shelf life, correlate to weaker turnover rate. Consequently, it is important to plan supply and alternative solutions to ensure the availability of products with good remaining shelf life. Therefore, it is important to have problem-solving ability since it is difficult to define what structural properties make organizations adaptable (Staber & Sydow 2002). The importance of adaptive capability emphasizes in a rapidly changing business environment. Finding strategic solutions that will ensure the greatest level of adaptability is more relevant than cost-efficiency based strategies (Christopher & Holweg 2011). Developing flexibility by creating alternative production plans and versatile plans to amplify flexibility is also recommended (Brusset & Teller 2017).

Also, supplier's process of fulfillment of orders was evaluated. As results indicate, product availability was a significant factor for supplier performance according to the customers. Results of customer satisfaction about this indicates that customers have divergent opinions about the supplier's ability to have products in stock. Additionally, customers pointed out that there have been some challenges with the availability of the products. The results indicate that product availability should be considered as future improvement area and stock availability should enhanced in order to improve supplier performance. It is also recommended to take into account the stock management aspect and sufficient product availability when entering new markets in order to attain customers' expectations. Since the stock shortages are usually linked to demand fluctuations, research shows that strategy of building structural flexibility enables the adaptation structurally accordingly to demand (Christopher & Holweg 2011). Therefore, focusing on creating flexibility in both in sourcing and order fulfillment is recommended. Literature has proven that these capabilities improve the level of resilience in a supply chain (Pettit et al. 2010).

Also, since availability of goods is linked to case company's own suppliers' capacity to supply goods, it is recommended to create redundancy in case of a disruption. It provides capability to maintain the capacity to respond to the disruption (Rice & Canioato 2003). This is important since increased collaboration and network environment, risks can transfer between

the companies (Hallikas et al. 2004). Some critical suppliers in the supply chain network should be identified. Not only strategic partners should be involved since certain suppliers may become bottlenecks that limit the recovery due to their position in a network. Therefore, developing a collaborative relationship is suggested with certain suppliers to provide support during disruptions and enabling better recovery. (Yan et al. 2015) Also, knowledge after disruption can be utilized and shared among the parties by creating organizational learning mechanisms (Jüttner & Maklan 2011) which facilitates a firm become more resilient (Nonaka & Toyama 2007). Thus, by ensuring continuous and timely supply from these suppliers, firms can design more resilient and responsive supply chain (Yan et al. 2015).

As a part of this fulfillment of orders process, especially effortless ordering was important from customers' perspective. Overall, the customer satisfaction of current ordering system seems to be on a good level. However, there were opposite customer experiences in the easiness of ordering via current system. Therefore, usability of order system is recommended to be evaluated before entering new markets. Also, order process should be effortless and clear information of ordering schedules should be provided for new customers. Also, research points out that supply chain parties should share information in real time by having well defined communication channels (Gunasekaran et. al 2015). When both integration and flexibility capabilities are combined and developed, resilience is also created (Brusset & Teller 2017).

Overall, delivery reliability is seen as a considerable part of supplier performance. The results highlighted especially the importance of timely deliveries. The supplier has performed well in this area according the results, and no challenges had risen due to this factor. As questionnaire indicated, customers appreciated the characteristic of flexibility if something unexpected occur and changes need to be done related deliveries and orders. There have not occurred significant challenges in this area of supplier performance, as the results indicated that customers were quite satisfied with the level of flexibility of the supplier. It is also important to take the flexibility aspect of supplier services into account when entering new markets. Also, customers highly valued the accessibility of customer service and they reported that it is very important that customers have the opportunity to contact supplier. Research also supports this finding since creating flexibility in order fulfillment has been recognized to be one of supply chain capabilities that correlate positively to supply chain resilience (Pettit et al. 2010).

Overall, customer satisfaction and supplier's overall performance were on a good level. Also, the net promoter score was calculated since it provides valuable information for growth. The more promoters company has, the bigger its predicted growth is. Monitoring of the development of net promoter score is also suggested since with the help of this score, more detailed information can be obtained and contribute for future growth in both prevailing and new markets. Also, the areas of customer experiences and supplier performance are recommended to analyze further since, according to research, sustainable growth begins with finding ways to create more promoters and less detractors, as well as making the net-promoter number visible in a company. (Reichheld 2003) As a conclusion, summary of managerial implications based on the research are represented.

Summary of managerial implications for the case company

- Implement strategy which supports resilience, by having supply chain design principles that improve the level of flexibility
- Improve supply chain visibility by having detecting and control systems
- Create resilience capabilities, especially structural flexibility, redundancy and improve the level of collaboration in a supply chain in order to adapt to demand fluctuations
- Follow main vulnerability drivers in order to create balanced resilience capabilities
- Improve the adaptability to the uncertain environment of new markets by having a customer orientation
- Ensure the availability and sufficient shelf life of products
- Follow the development of net-promoter score and find ways to increase the number of net-promoters

Limitations & future research

While extensive research is conducted for a case company, this study has also limitations which are needed to take into consideration. The concept of resilience is applied also in numerous fields other than supply chain such as ecology, individual and organizational psychology, and safety engineering (Bhamra et al. 2011). This research topic only focuses to supply chain area and more specifically strategic supply chain management.

Resilience is also directly linked to risk management area (Ponomarov & Holcomb 2009), however this research excludes risks and risk management areas in supply chains. Since, supply chain risks and risk management are very close conceptually to supply chain resilience, it is used only to provide necessary information. More widely the topic of risks and risk mitigation strategies are excluded. Also, they are left out because the aim is to gain new knowledge about disruptions affecting to the case company's supply chain.

Product launch process is also not included to the extent of this research. This topic only focuses to supply chain area. Other areas of product launching process such as marketing are not examined. Also, the different stages (such as identifying and defining target markets and assessing market development) of entering new markets are excluded, since these are conducted already by the case company. Furthermore, the case company has already conducted a wide quantitative customer survey for target customers in new markets, so evaluating customer preferences in the new markets is not included.

Also, since this research is based on an individual case company, the results of empirical part of the study cannot be generalized. First part of the empirical research is based on subjective vulnerability mapping and the results imply only to the case company's prevalent situation and industry characteristics. So, the results of this study are only valid to this company's context since every company has their own unique supply chain design and network. This research is tied to context and the suggestions for this company may not be valid to other companies even in the same industry. Theoretical part is thus valid to generally.

Second part of empirical research was conducted by questionnaire in which current customers in prevailing markets responded. Therefore, data is collected from subjective perspective and considered in a reliability of the research. Furthermore, status of supplier performance is only evaluated by customer's perspective and other metrics of performance are not included. There was total of 18 responders which represents only a minority of current customer base, so it

sets limitations to the interpretation of the results of empirical research. Wider sample should be taken to create more accurate understanding of supplier performance in prevailing markets. Furthermore, some customers have only received a few deliveries, so it was too early for them to evaluate certain areas asked in the questionnaire about supplier performance. This correlates to limited knowledge of present challenges in current markets and works only as a guidance of what challenges there might be in new markets. In addition, the customer experiences are evaluated in order to detect possible challenges and disruptive events. So, overall customer satisfaction was evaluated only with the aim to find areas which take into consideration when the subsidiary (case company) is entering new markets. Thus, interesting topic for future research for the case company would be conducting the research of supplier performance for a wider customer base and monitoring the development of supplier performance areas. Also, the same research is possible to conduct in the new markets as well after the product launch, which would provide valuable knowledge of target markets customer preferences.

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Appendices

Appendix 1.

The Vulnerability Assessment Model

The consequence is assessed in a scale of 1-5:

1 = No effect

2 = Minor effect

3 = Moderate effect

4 = Major effect

5 = Catastrophic effect

The likelihood is assessed in a scale of 1-5:

1 = Very low

2 = Minor

3 = Moderate

4 = Major

5 = Very high

	Consequence	Likelihood
Demand related challenges		
Demand in the industry is generally declining or growth in the industry is stopping unexpectedly.	3	2
Economic downturn begins in an industry or geographical area with a significant number of end customers.	3	1
The competitiveness of the customer's products is weakening.	3	3
The order forecasts given by the customer do not materialize, and the orders remain smaller than the forecasts.	4	3
The customer's new product model or its timing fails in the market.	2	3
The customer's customer does not trust the delivery capacity of the network.	4	3
The ownership of a customer company changes or the customer merges with another company.	2	2
The customer reduces the number of suppliers, for example due to the increase in delivery entities.	3	2
Customer requirements in terms of technology or volume are changing and our company is unable to meet the new requirements.	3	1
We lose customer confidence due to poor security of supply.	3	3
We lose customers trust due to quality issues.	3	2
We lose customers trust due to leaks of confidential information.	3	1
The customer finds more competitive suppliers outside the network: for example, a large international company dominates the market.	3	1
Our company's position in the customer's network is weakening because our company does not have the resources for the internationalization required by the customer.	3	1
Our company enters international market with the customer, but the demand does not meet expectations.	2	2
The company's order backlog is decreasing due to delivery / capacity problems in the network.	4	3
Problems in cost management & pricing		
Background questions:		
Does the company know the cost structure of the customer's final product and the company's own contribution to it?		Approximately
Has working in the network caused changes in product pricing or price levels?		To some extent

Is pricing done open book?		With some customers
Has networking changed company's cost management or cost accounting system?		To some extent
Does the company have partnership with customers which focuses to reduce costs?		To some extent
Labor costs rise.	2	2
Costs are not flexible when volume fluctuates.	3	3
The difficult predictability of demand imposes additional costs.	3	4
Loss due to quality deficiencies.	3	3
Production equipment is not capable of cost-effective production.	3	2
Working capital grows unnecessarily large as business volume increases.	4	2
Working capital increases due to material responsibility and larger entities.	4	2
Responsibility for buffer stocks is transferred from the customer to the company.	3	2
Responsibility for buffer stocks is transferred from the company to suppliers.	2	3
Expansion investments increase the company's gearing.	3	3
The size of the investment increases in proportion to the company's resources.	4	1
Internationalization, or the pressure to do so, poses great investment needs.	2	1
The investment cycle is accelerating.	3	2
The wrong kind of investment is being made.	3	1
Investments are directed at too narrow field of expertise, which will not be used in the future.	2	1
The decision criteria of the investment are not sufficient, ie. the estimated investment income / expenses at the time of making the investment do not materialize as estimated.	3	2
A customer-specific investment is made that has no use after the product fails.	2	3
The company is under pressure to invest more.	2	1
Interest rates are rising sharply.	3	2
Exchange rate fluctuations cause interest rate losses or margin problems.	2	2
Funding is a major bottleneck for the development and expansion of operations.	3	2
The company's own pricing fails.	3	2

The market price determines the price, and this cannot be matched.	4	3
Price competition in the sector is getting out of hand.	4	2
The entry of a large international competitor into the market lowers the price level.	3	2
The customer has great power over the price of the product.	3	4
The constant decrease in prices weakens the company's profitability.	4	2
Product pricing does not work properly in all situations.	3	3
The customer demands an unreasonable price reduction from the supplier in the short term.	4	2
The company does not know the added value that the product brings to the end customer.	4	1
Problems with fulfillment of delivery (delivery times / quality)		
Background questions:		
How many % of the information flows in the company's order-delivery process are transmitted electronically?		>90%
Delivery time of purchases in relation to own delivery time.		Longer
The level of strategic cooperation in the supply chain in relation to customers.		High
The level of strategic cooperation in the supply chain with suppliers.		Moderate
Number of substitutive customers for the company		Low
Number of substitutive subcontractors for the company		Low
Deficiencies in production planning cause problems in meeting deliveries.	4	3
The company's project management ability fails in larger delivery entities and deliveries that require high technological knowledge.	2	1
Creating larger delivery entities makes it difficult to manage the delivery process.	2	2
Errors and usability of the company's ERP system.	3	1
Inventory shortages prevent delivery from being completed.	4	4
Deliveries are delayed due to temporary capacity shortage (required machinery / staff capacity).	3	3
Longer-term machine / staff capacity is not enough for growing production volumes.	3	2

Repeated unexpected problems and interruptions in production, eg. due to long set-up times and / or new product models.	3	2
Unsatisfactory reliability and performance of production equipment (possibly no redundancy, spare parts are expensive or not available quickly enough, difficult to repair).	2	1
Production lead time is too long.	3	2
There are large variations in the predictability of production lead time.	3	3
Too wide a range of products makes it difficult to control the production process.	2	2
The company has difficulty meeting customer quality requirements.	3	1
The material (raw material) acquired in the warehouse has become unusable (obsolete) or otherwise unsuitable for the final products.	2	4
The poor competence of the staff makes it difficult to meet deliveries.	3	1
Problems in accessing skilled labor.	2	3
The company's key person (s) will leave the company's service.	3	3
The customer is tightening delivery time requirements that cannot be met.	2	2
Inaccuracies in forecasts in the network cause problems.	3	2
Business-to-business information systems are not compatible, causing delivery delays and errors.	3	1
The life cycles (ramp-up / ramp-down) of the customer's products are not as planned.	2	2
Significant quality problems are not detected before delivery to the end customer.	3	1
Customer's product specifications are inaccurate / incorrect.	3	4
The operating environment of the final product is not known in the network.	2	3
Information about changes in product requirements is not transmitted online.	2	1
The security of supply of the company's own subcontractors causes problems in fulfilling deliveries.	4	2
The delivery time of the company's own subcontractors / material suppliers is too long.	3	2
The availability of critical (inexpensive and / or difficult to obtain or replace) material has not been	1	2

ensured and the material is not available when needed.		
Difficulties in accessing external services (eg. design, information systems, maintenance, subcontracting machines, or production methods).	1	1
Certain partnership fails (eg. material supplier is unable to adhere to contracts).	2	1
Long procurement times undermine the reliability of deliveries.	1	1
Supply Chain Sustainability		
Customers' expectations regarding responsibility cannot be met.	2	1
The customer does not order the product due to the origin of the product.	3	3
The supplier does not meet the requirements for sustainability.	4	1
The supplier product does not meet the principles of sustainability/responsibility.	3	1
Supply chain responsibility/sustainability has an impact on a company’s brand.	3	2

Appendix 2.

Customer survey of supplier performance

The importance of different criteria is assessed in a scale of 1-5:

1 = not important

2 = little important

3 = quite important

4 = important

5 = very important

The extent of these criteria met by the supplier and performance of different areas is assessed on a scale of 1-5:

1 = not at all satisfied

2 = not satisfied

3 = quite satisfied

4 = satisfied

5 = very satisfied

Quality

How important do you think that the remaining shelf life is when a product is delivered to you?

How satisfied are you with the remaining shelf life of these products?

How important an attractive design of product's packaging is for you? (appearance, color, shape, etc.)

How satisfied are you with the current design of supplier's products?

How important it is that the consumer can recycle the packaging after the product has been consumed?

How satisfied are you with supplier’s packaging regarding the possibility for the end user to recycle?

How important is the origin of a product?

How satisfied are you with the countries of origin that supplier has chosen for its products?

How do you feel supplier's overall product quality is compared to similar products in the same category?

Fulfillment of orders and logistics

How important is the turnover rate of these types of products? (from the time you receive the product in your warehouse until it leaves the checkout)

How satisfied are you with products' turnover rate?

How important do you think reliability in deliveries is? (delivery quantity matches the order placed, the order arrives on time, etc.)

How satisfied are you with supplier’s delivery security?

How important do you see the availability of products and that there are enough products available in stock to order?

How satisfied are you with supplier's ability to have products available in stock?

How important flexibility is for you, when it comes to making changes in orders and deliveries when something has gone wrong?

How satisfied are you with supplier's flexibility when it comes to making changes in orders and deliveries?

How important timely deliveries are from your perspective?

How satisfied are you with supplier's ability to deliver on time?

How important a simple ordering process of products is for you?

How satisfied are you with supplier's current ordering process?

How important is the availability of customer service?

How satisfied are you with the opportunity to get in touch with supplier?

How important is the type of logistics solution that suppliers offer?

How satisfied are you with supplier's current logistics solution?

Customer satisfaction

How satisfied are you with supplier's overall performance as a supplier?

How likely you would recommend supplier as a supplier to other stores?

Open questions

What do you think is good about this concept?

Give some examples that you think are particularly important regarding a supplier's customer service?

Do you as a customer feel that there is something that has been particularly challenging with supplier’s products?

During the time you have had supplier’s products in your store, has there been any special events that you have experienced as disturbing?

If you have had incidents that have been disruptive, how do you prefer these to be handled in the best way?

If there have been problems with deliveries, what kind of problem has there been?

If there have been delivery problems, how do you think these have been handled by supplier?

If you have had delivery problems with supplier, how do you think these can be prevented?

Have you experienced any other challenges in the collaboration with supplier, if so, please specify?