CHALMERS
UNIVERSITY OF TECHNOLOGY

Building resilient supply chains through supply chain planning advancements

A case study mapping current resilience capabilities

Master's thesis in Supply Chain Management

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Abstract

The world has recently been struck by many different types of disruptions, affecting the supply chain's performance, such as a global pandemic. A consensus in business is that changes are needed in some of the current supply chain's strategies to stay competitive and resilient. Supply chain resilience and the concept of developing a resilient supply chain have thus become a part of many companies' agendas. The development of capabilities to respond to, or minimize disruptions impact.

The thesis has thus focused on developing current supply chain resilience capabilities at the case company Ericsson. This has been done by analyzing past disruption cases, with different types of origin, to investigate the current state of Ericsson's capabilities. The data was gathered by interviewing involved employees in respective disruption, gathering information about the different activities and strategies applied when mitigating the impact.

The case data was then analyzed individually and across the cases. The mitigation actions and strategies were then analyzed and then categorized into the adapted resilience capability framework. Ericsson proved to apply many anticipative and adaptive capabilities during the different disruptions, leaving no significant gap in the framework used. Even though no significant gaps were found in the framework, some areas of improvement were identified. The improvement suggestions are connected to Ericsson's ability to sense and map their vulnerability, information and data management, disruption processes, and leveraging and structuring post-disruptive feedback sessions.

Keywords: Supply chain resilience, Resilience phases, Supply chain capabilities, Resilience capabilities, Capability framework, Supply chain planning

Acknowledgments

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We would like to show our sincere gratitude to our supervisor and mentor at Ericsson, Dan Widerström, for the never-ending expertise, feedback, and guidance along with the master thesis. Without the many discussions we have had, it would not have been possible to conduct the study. Your commitment, support, and inspiration have helped us immensely in the project.

We also wish to express a special thanks to Jonas Fransson and the rest of the Networks Planning team at Ericsson for letting us feel a part of the teams and giving us support and guidance throughout the thesis. An additional thankfulness to all employees who participated in our interviews conducted at Ericsson. Without the valuable insights of our interview objects, the case study would have been hard to do.

Further, we want to give immense gratitude to our supervisor and examiner at Chalmers, professor Patrik Jonsson, for the invaluable knowledge and insights he has given us. Both within the field of the study handing out relevant research, in parallel to guiding us through the academic landscape and giving us ideas on how to improve our delivery.

Anton Norlander & Samuel Wallson
Gothenburg, June 2022

List of Acronyms

Below is the list of acronyms that have been used throughout this thesis listed in alphabetical order:

BCP	Business Continuity Planning
ICT	Information and Communication Technology
LTB	Last-Time-Buy
PDU	Product Development Unit
PTS	Post- och Telestyrelsen (Swedish Post and Telecom Authority)
S&OP	Sales and Operations Planning
SCRES	Supply Chain Resilience
SCRM	Supply Chain Risk Management

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1

Introduction

The introduction will highlight the background description of why and how the subject is relevant to research and the connection it has to the case company, Ericsson. Further, the purpose, together with the research questions is introduced. Moreover, it will also include delimitations to narrow the scope.

1.1 Background

The trends within industries have long been globalization, as a natural way of expanding their business from the domestic markets and reaching out to all parts of the world. This has over time led to global supply chains with increasing complexity and length (Blackhurst et al., 2005). The importance of good practices and management of the company's supply chain has thus made it into the top management agenda.

McKinsey Global Institute (2020) states that supply chain disruption can cause on average a loss equivalent to 45 percent of a year's profit spanning over a decade. These disruptions have been seen very recently, with ongoing disruptions ranging from the semiconductor shortages, the shipping crisis with increased logistics costs and substantial delays, to the 2010 Icelandic volcano eruption of Eyjafjallajökull that heavily impacted supply chains in the region. Disruptions are also believed to continue to rise in frequency, but remains a discussion point in academia (Jüttner & Maklan, 2011; Polyviou et al., 2019).

In a recent survey, Gartner (2020) claims that 21 percent of organizations have highly resilient networks with good visibility and agility to shift distribution, manufacturing, and sourcing rapidly. This shows the lack and cements the need for resilience improvements in organizations. To minimize possible impacts of a supply chain, companies should work proactively with the development of resilience abilities to react, and cope with disruptions better (Schmitt & Singh, 2012). As there are many ways to achieve resilience in a supply chain, this thesis takes a starting point in what ways Ericsson can develop its resilience, to be more prepared for future disruptions.

1.1.1 Case Study at Ericsson

In this study of Supply Chain Resilience (SCRES), Ericsson has been chosen as case company for the thesis. Ericsson is a Swedish global actor within the Information and Communication Technology (ICT) sector. Ericsson was founded in 1876 and was from the beginning a telecom provider. Over the years Ericsson has evolved their product portfolio, deploying products and services to customers in more than 180 countries (Ericsson, 2022). Today, the focus is on implementing 5G network in the company's different market areas: North America, Europe and Latin America, Middle East and Africa, North-East Asia and lastly South East Asia, Oceania and India. Ericsson is a leading provider of solutions within mobile connectivity, striving for the strategic position of technology leadership. Ericsson is handling around 40 percent of the world's total mobile traffic, making them a large actor within the sector and playing an important role in connecting the world.

Ericsson has historically faced multiple disruptive events. The impact of a lightning bolt strike on a sub-supplier plant caused an estimated 400 million revenue loss and had a great impact that ultimately led to a withdrawal from the mobile phone market (Norrman & Jansson, 2004; Elgin, R. 2003). A recent disruption that has had a major impact on business across the whole landscape is COVID-19. The ripple effects stemming from it can still be recognized. The annual report from 2020 describes the disruption of critical components due to increased uncertainties that are still affecting their supply chain (Ericsson, 2021). This is captured in their most recent annual report, where Ericsson's ability to adapt to the current supply chain environment is praised internally.

"We also saw a continuation of the pandemic and the difficulties it caused, such as global supply chain issues and economic disruptions. Once again, Ericsson demonstrated its ability to adapt to demanding realities by strengthening SCRES..."
(Ericsson, 2022 p. 11).

The mitigation of these disruptions impact through increased resilience can enable great revenue improvements as shown, and increase competitive advantage.

1.2 Problem Discussion and Research Questions

This study aims to evaluate and define Ericsson's Networks Supply Chain preparations for a future disruptive event; thus its Supply Chain Resilience. To know how the disruptions can affect a company, it is crucial to understand what consequences and impacts a disruption can have and what strategies activities and strategies are applied to reduce and minimize the impact. The impact of disruptions differs a lot depending on the company's specific setting; thus also the consequences, and the actions taken based on the impact on the supply chain. This builds up an understanding of the usefulness of different SCRES practices.

Not all disruptions are connected to all functions of a company. Some disruptions

may only affect one or two teams e.g. sourcing or R&D, while other disruptions may affect the whole supply chain network and the entire organization simultaneously. Therefore it is of importance to map what parts of the organization that have been affected and have experiences connected to the chosen case disruptions. Understanding the connection and relation outlined between them gains insights into their collaboration and activities performed.

With this as a foundation, it is possible to start to analyze and investigate what various resilience capabilities are currently possessed to minimize and reduce disruption's effect on the supply chain. Three case disruptions were chosen in collaboration with the company to gain insights into this area when different parts of the supply chain were affected. One case on the supply side, one case on the demand side, and lastly a case that affected their whole supply chain. With these cases, substantial knowledge of how they mitigate disruptions in the different domains is hoped to be obtained. There is a limited amount of research within academia on the intersection of how supply chain planning can manage to provide resilience. The master thesis aims to provide additional research and insights within this cross-section seen in *Figure 1.1*.

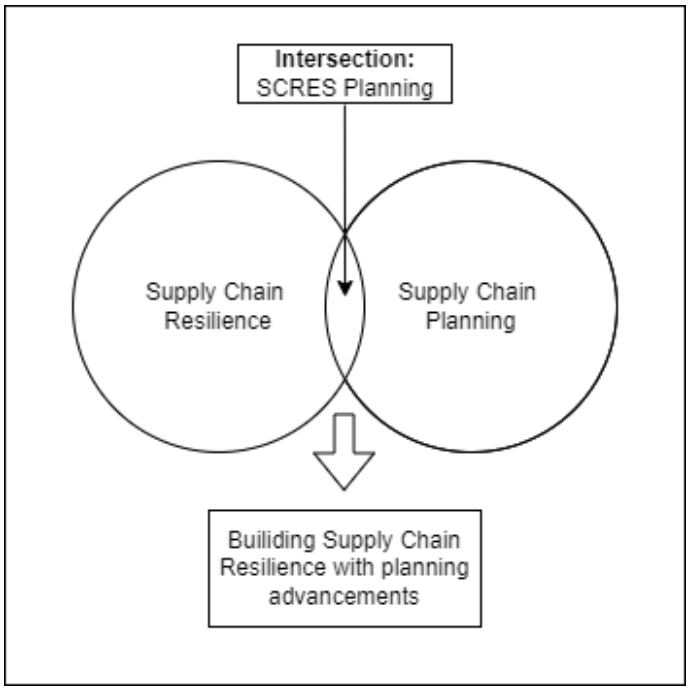

Figure 1.1: The given intersection of the master thesis.

Based on the background provided and the problem discussion outlined, three research questions have been stated to specify and concretize what is to be studied at Ericsson.

1. How has Ericsson handled previous, chosen, disruptions?
   (i) What impacts and consequences have the supply chain disruptions had?
   (ii) What processes and internal supply chain parties were involved?

2. What resilience capabilities does Ericsson's supply chain possess and apply to reduce the impact of a disruption?

3. Given the current SCRES and Capabilities, what improvement areas can be identified within supply chain planning?

1.3 Delimitations

The case study on SCRES is done from the perspective of Ericsson. As SCRES affects many areas of business operations the scope of the research has been narrowed down to focus on its implications for Ericsson Group Supply - Business Area Networks Supply Chain. The study will proceed from the different cases rather than focusing on a specific area of supply chain planning. The thesis will thus not focus on a specific planning process, and therefore develop a general picture to provide an overview of current resilience capabilities. A further limitation of the research is the disruptions that the report covers. Three disruptive cases have been chosen that cover a broad segment of the different types of disruptive events that can hit a supply chain. The authors are thus not able to fully cover all the implications that different types of disruptions have within Ericsson's different functions.

1.4 Report Disposition

The following outline contains the different chapters with a short description to provide an overview of the thesis's structure.

1. *Introduction*
   Provides background and understanding of the area of SCRES and supply chain planning together with information about the case company Ericsson. Secondly, the problem discussions with the belonging research questions and delimitations found in the thesis are presented.

2. *Literature review*
   Presents the findings of previous literature found connected to the thesis. Included in the chapter is a way of categorizing supply chain disruptions, the area of SCRES includes vulnerabilities and capabilities. This builds up the used framework that lays the foundation and structure used in the empirical data, analysis, and discussion. Lastly, supply chain planning and S&OP is described to provide a bridge between resilience and planning.

3. *Methodology*
   Describes the research methodology and methods used in the study. The chapter covers the research strategy, case selection process and data collection with analysis methods. It also covers a discussion of the method's reliability and validity.

4. *Empirical data and cases*
   The empirical findings in this thesis start with an introduction of the case company and their planning structure with some of the present resilience work. Secondly, the data from the cases and interviews are presented and segmented into the SCRES categories followed by a summary in a table, case by case.

5. *Analysis and Discussion*
   This section provides an analysis with belonging discussion to answer the formulated research questions. The cases are first analyzed individually and then cross-case. It is followed by an overview of the possessed and applied resilience capabilities and the gaps and improvement areas identified. The section ends with a discussion of the academic implications and future research.

6. *Conclusion*
   The authors conclude the findings from the thesis and answer the purpose of the study.

2
Literature Review

The following chapter provides the theoretical foundation for the area of study. The main themes are Supply chain disruption, SCRES, SCRES vulnerabilities and capabilities, and lastly supply chain planning with relevant processes and their involvement in creating reactive and/or proactive capabilities. The literature is then used to analyze the data presented in the empirical findings chapter.

2.1 Supply Chain Disruptions

Supply Chain Disruptions could be defined as: *"The combination of (1) an unintended, anomalous triggering event that materializes somewhere in the supply chain or its environment, and (2) a consequential situation which significantly threatens the normal business operation of the firms of in the supply chain"* (Wagner & Bode 2008, p. 309). Disruptions can result in loss of profits, increased costs, and even damaged company reputation (Wagner & Bode, 2008; Hendricks & Singhal, 2003). A recent survey by Business Continuity Institute (2018), stated that 56 percent of the organizations suffered from supply chain disruptions during the year, and over half of them occurred at the tier 1 supplier level. 14 percent of the respondents calculated the yearly cumulative cost of the disruptions to be more than one million euros. Further, one out of six respondents did not even know if a disruption had an impact on the company (Business Continuity Institute, 2018).

Even though the number of disruptions had decreased from 2010 to 2018 (Business Continuity Institute, 2019), COVID-19 led to an increase in supply chain disruptions globally (World Economic Forum, 2021). Disruptions can affect both global and local supply chains. Past examples are hurricane Katrina in New Orleans, 2005; the tsunami in the Indian ocean in 2004; or ships getting stuck in the Suez Canal, both in 2004 and 2021 with the Ever Given ship (BBC, 25 March 2021). According to a survey done on practitioners by Donadoni et al. (2019), the most feared disruptions are quality incidents, demand risks, and network risks.

2.1.1 Classification and Categorization of Disruptions

All disruptions have risks connected to them, some with higher probability than others and some might be easier to calculate the impact. McKinsey (2020) mapped different types of disruption and how the impact connects to anticipation ability in *Figure 2.1.*

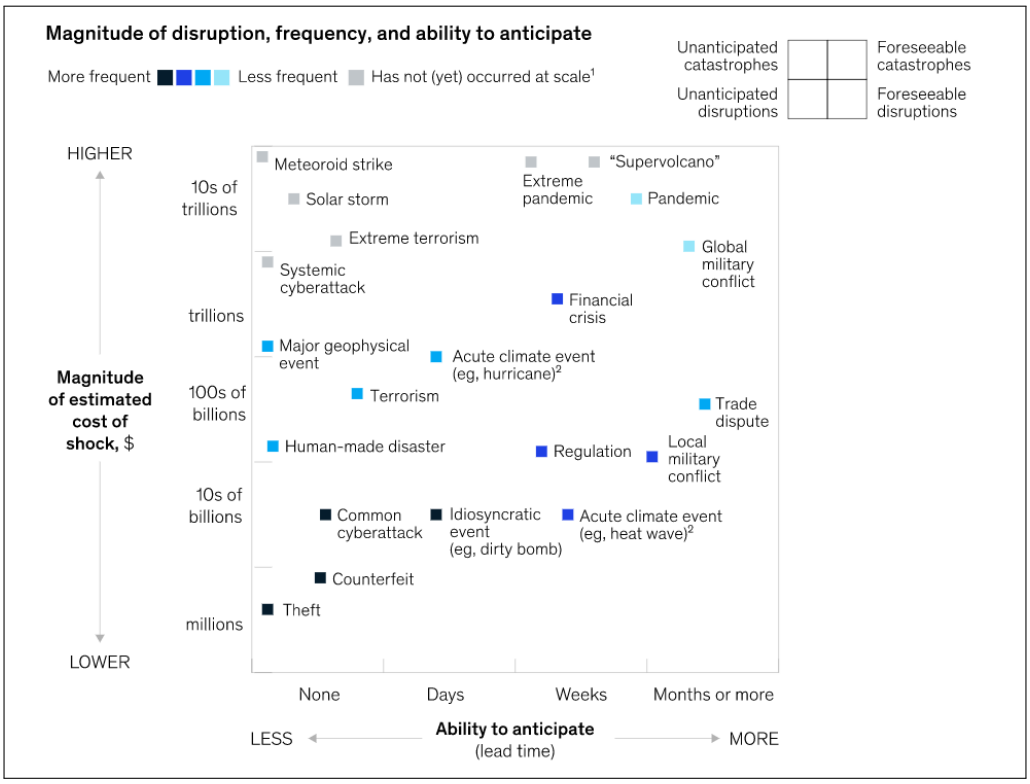

Figure 2.1: A disruption classification. Adopted from McKinsey (2020).

There are multiple other types of classifications and categorizations in literature. Tang et al. (2006) mean that a general categorization is to divide risks into operational- and disruption risks. Operational risks are linked to inadequate or failed processes, people, and systems whilst disruption risk is defined as unplanned events that restrict a supply chain system.

To understand and categorize different disruptions, and what scenarios firms are to be resilient to, a categorization framework of disruptions was created, viewed in *Figure 2.2*. The chosen framework was adapted and modified from Katsaliaki et al. (2021) and categorized into two different sections, macro-, and internal supply chain disruptions. For visualization purposes a couple disruptions were combined or intentionally left out. Sawik (2014) means that organizations can suffer from three types of risks: individual, local and global disruptions. The macro supply chain disruptions are seen as global or regional supply chain disruptions that can create multiple disruptions in the internal supply chain simultaneously and can also heavily affect all types of supply chain branches, not only one specific branch or company. Examples of macro disruptions are natural disasters, war, and pandemics. The internal supply chain disruptions are local and individual divided into four subcategories: supply-side disruptions, demand-side disruptions, logistic- & transportation disruptions, production & infrastructural disruptions. The last two are categorized as disruptions that impact the focal company within the internal node and links.

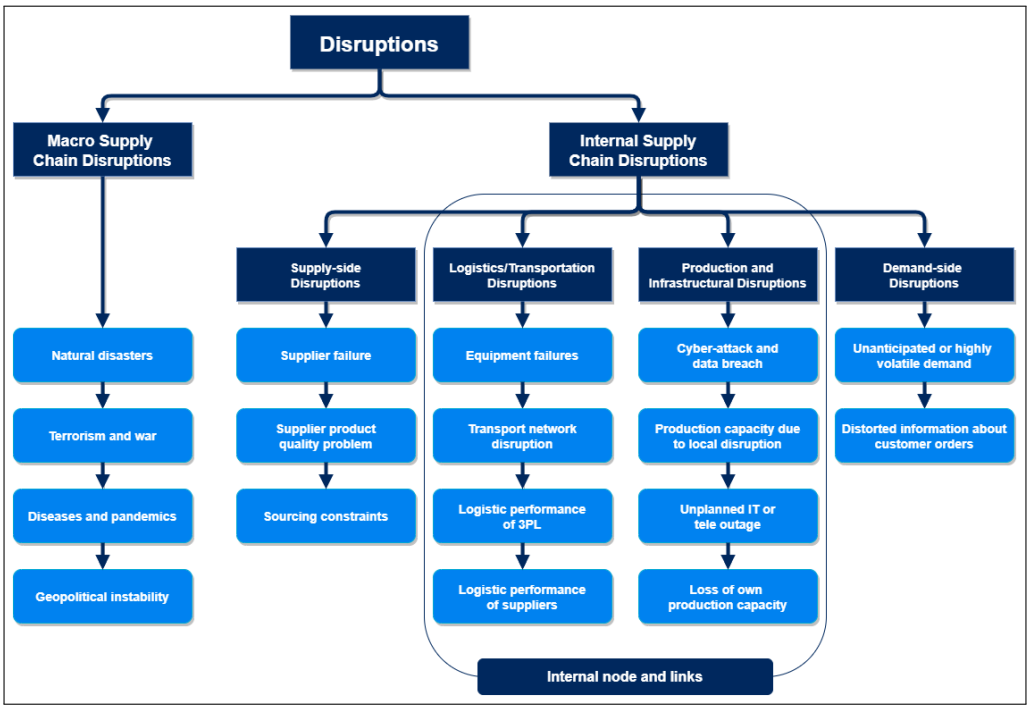

Figure 2.2: Disruption framework modified from Katsaliaki et al. (2021).

A notion to the framework is that the displayed disruptions are sorted in the frequency of occurrence based on Katsaliaki et al. (2021) research. It is hierarchized from low to high in the frequency of occurrence, which means for example that supplier failures e.g. bankruptcy, and company buyouts are less frequent than supplier product quality problems e.g. product recalls and rejected parts in the supply-side disruptions category.

2.1.2 Supply Chain Risk Management

One approach to handle these disruptions could be with Supply Chain Risk Management (SCRM) methods. Jüttner et al. (2003, p. 231) defines it as *"the identification of appropriate strategies through a coordinated approach among supply chain risk members, to reduce supply chain vulnerability"*. However, researchers argue that SCRM might be too time-consuming and costly in comparison to money saved (Sigler, et al., 2017; Norrman & Jansson, 2004). Marcucci (2019) states that the greatest weakness lies in its ability to adequately handle low-probability high-consequence events. This weakness is argued to be captured by the idea of resilience, as a complement to the SCRM processes (Fiksel et al., 2015). The fact that the results of traditional SCRM often do not capture the low-probability high-consequence events paves way for SCRES to be better prepared for future disruptions.

2.2 Supply Chain Resilience

Building a resilient supply chain can achieve substantial rewards according to Sheffi (2005). Not only by resisting disruptions more effectively but also through increased competitiveness. The definitions of SCRES are many with similar meanings. Kochan and Nowicki (2018) suggest a lack of consensus in academia. Therefore the authors have then chosen a commonly cited definition of SCRES that was found suitable for this setting made by Tukamuhabwa et al. (2015).

"The adaptive capability of a supply chain to prepare for and/or respond to disruptions to make a timely and cost-effective recovery and therefore progress to a post-disruption state of operations - ideally, a better state than prior to the disruption" (Tukamuhabwa et al., 2015, p. 8).

A commonality between the different definitions is the concept of abilities and capabilities connected to SCRES. The objective of working with SCRES is thus to develop adaptive capabilities to be better prepared for unexpected events; anticipate, respond, and recover from disruptive events (Jüttner & Maklan, 2011). This will be the type of resilience referred to, when the term is brought up throughout the rest of the report.

Research and publications in the area of SCRES have grown exponentially since its introduction, proving the growing importance of the subject (Pettit et al., 2019). Moreover, multiple disruptions have since the publication impacted the supply chains globally e.g. COVID-19, the semiconductor crisis, and the global shipping crisis which have led to even further growth of the subject.

2.2.1 Supply Chain Resilience Phases

The previously presented definition of SCRES suggests four phases; a prepare, resistance & response, recovery, and growth phase. A concept for analyzing and visualizing the different phases of resilience is within academia referred to as the Resilience Triangle (Bruneau et al., 2003). That has been adapted into the supply chain area; resulting in the SCRES Triangle, see *Figure 2.3*.

Tukamuhabwa et al. (2015) visualizes the impact of disruption and the different phases that affect Supply Chain Performance over time. It further visualizes the magnitude of impact on system performance that the disruption has had. While it adds the element of time to show the disruption's impact on performance while the negative impact lasts, the green marked area. The capabilities of an organization's resilience in each phase will thus determine the response and the impact on the supply chain's performance.

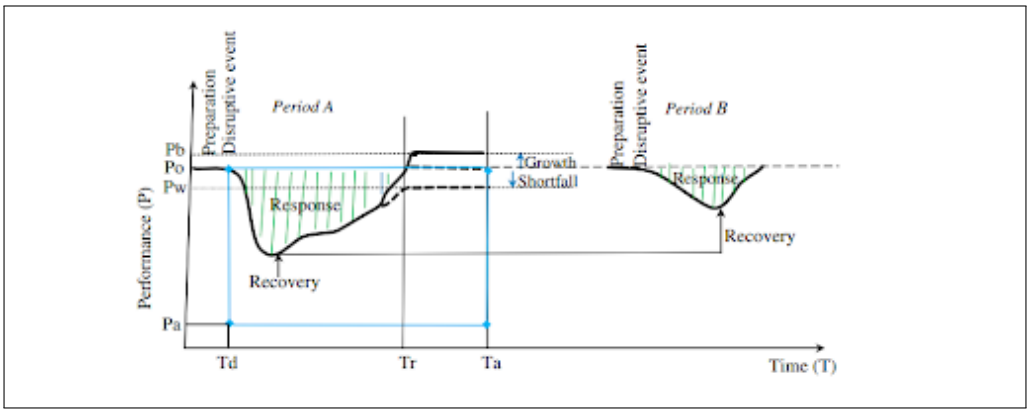

Figure 2.3: Adaptation of the resilience triangle including the four main aspects of SCRES plotted by Tukamuhabwa et al. (2015).

The capabilities that a firm can possess are by Ali et al. (2017) divided into the same stages visualized. The time before disruption (Td) refers to the preparatory stage; where proactive strategies are considered such as abilities to anticipate and build up capabilities before disruptions. Td is the time of the disruption, examples of disruptions could be found in *Section 2.1*. During the disruption, two phases last until the performance is recovered (Tr); concurrent and reactive strategy making resulting in the responses and recovery of the disruption. Parts of the response are the time until response, assessing the situation, and controlling it to avoid further damage. The recovery actions are usually initiated in parallel to the controlling, but could even be prior if the disruption has been anticipated (Sheffi and Rice, 2005). The last phase brought up in some studies is the growth phase; which considers the opportunity to overcome and triumph over disruptive issues and come out on the other side performing better than before the disruption due to implemented measures.

Measurements of a company's resilience performance or abilities are difficult; as the characteristics of disruption vary, thus also the impact. In Donadoni et al.'s (2019) survey of academic experts, they seemed to have reached some consensus regarding what metrics are important. The findings indicated that the recovery time; the interval in time between the time of disruption and full recovery was the most cited KPI. Others in the top were metrics such as recovery cost, market share, and contingency strategies' cost.

2.2.2 Supply Chain Vulnerability

A critical factor in understanding and preparing for a disruptive event is to know one's supply chain's vulnerability. Azevedo et al. (2008, p. 48) define supply chain vulnerability as *"the incapacity of the supply chain, at a given moment, to react to the disturbance and consequently to attain its objectives"*.

The vulnerability differs between companies. Pettit et al. (2010) present three general sources of vulnerability: external, internal, and structural. The following part presents example vulnerabilities. Turbulence, such as natural disasters, the unpredictability of demand, and fluctuations in currencies and prices. External pressures in the form of competitive innovation, political, and regulatory changes. Resource limits such as supplier, production, and disruption capacity. A company can also be vulnerable by being too interdependent on entities outside the company's border.

Das (2018) presents the possibility of integrating resilience work into supply chain planning by modeling the supply chain and identifying its vulnerable functions. Ivanov (2020) also explores opportunities in implementing decision-making support and data-driven models through simulations, to help practitioners stress-test existing or alternative supply chain designs or plans.

2.2.3 Supply Chain Capabilities

Another construct of SCRES is capabilities; activities enhancing a firm's ability to be resilient (Ali et al., 2017). *"Whereas vulnerabilities can be considered 'factors that make an enterprise susceptible to disruptions', capabilities are 'attributes that enable an enterprise to anticipate and overcome disruptions'."*(Fiksel et al., 2015, p. 81). Ali et al. (2017) identified in their literature study five capabilities: the ability to anticipate, adapt, respond, recover, and learn, see *Figure 2.4*.

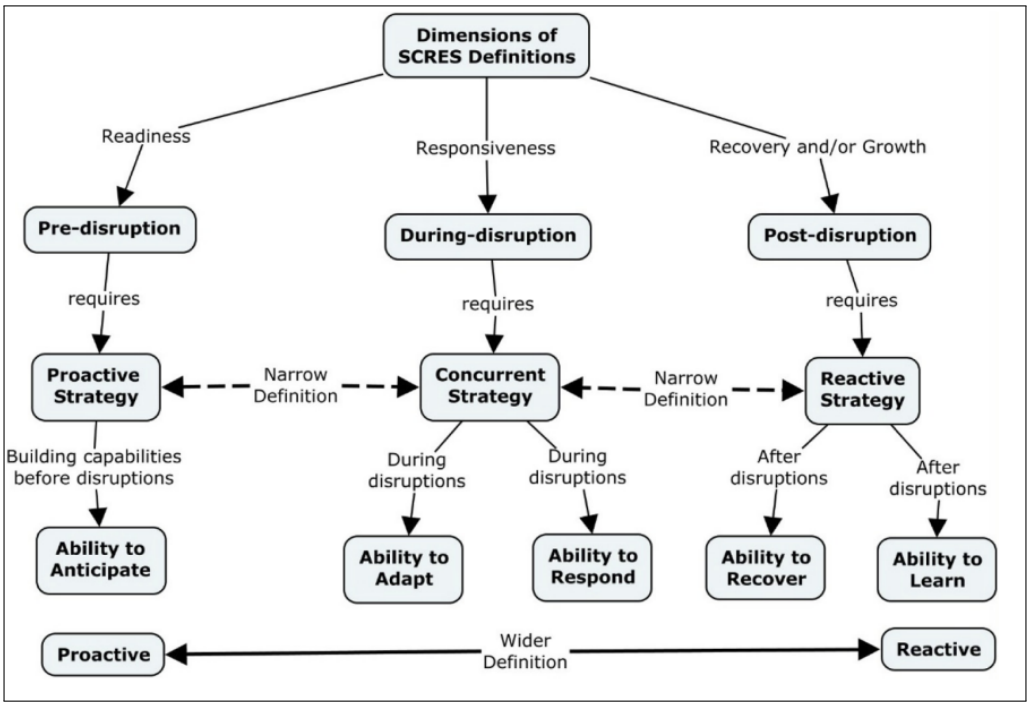

Figure 2.4: The three constructs of SCRES. Constructed by Ali et al. (2017).

The capabilities are similarly divided into the phases of disruption starting with the pre-disruptive phase which is made up of the ability to anticipate. The ability to anticipate enables proactive strategy development. The ability to anticipate includes elements such as abilities to identify and monitor potential events and risks, changing environments, performance, and the ability to connect how these affect the supply chain function.

During the disruption, Ali et al. (2017) identified two capabilities, the ability to adapt and respond. The first-named refers to the ability to manage and adjust critical supply chain resources and processes throughout a disruptive phase and/or under normal business circumstances. The other regards the ability to respond; react to events on time to decrease the impact or change the effect to shape the outcome into an advantage. Melnyk et al. (2014) present a complementing ability to Ali's, a resistance capability. The resistance capability refers to the supply chain's ability to delay and reduce the impacts of disruption.

The final two capabilities are categorized under the post-disruptive phase, consisting of the ability to recover and learn. Recovery capability considers a firm's ability to return to what's considered the new normal operation. Learning capability refers to the understanding and assessment of the responses made; to improve future performance and facilitate experiences.

2.2.4 SCRES Capability Framework

Figure 2.5 presents what the SCRES literature study has resulted in; a SCRES capability framework. There are three general themes as described in *Section 2.2.3*: Anticipation, Resistance & Response, and Recovery. The themes have sub-elements, some of them that are not seen as self-explanatory are presented in the following text while others are kept as description in *Figure 2.5*. The first theme, anticipation, includes capabilities such as situational awareness, visibility, robustness, building security, and pre-knowledge management. One of the elements of situational awareness is continuity planning; that refers to the plans of carrying out normal activities after an unplanned event occurs. Robustness regards the ability to endure changes, and involve anticipation of the change before it occurs. Pre-knowledge management relates to the understanding of the supply chain and its involved human resources can be used to become more resilient, by developing for example a SCRES culture. The resistance and response theme includes flexibility, collaboration, redundancy, and agility. The last theme, recovery, include contingency planning, market position, post-knowledge management, and building social capital. Contingency planning refers to actionable plans that are taken into place when an identified risk, or a disruption occurs. In this context fundamental parts are supply chain re-configurations, mobilization, and scenario analysis (Ali et al., 2017).

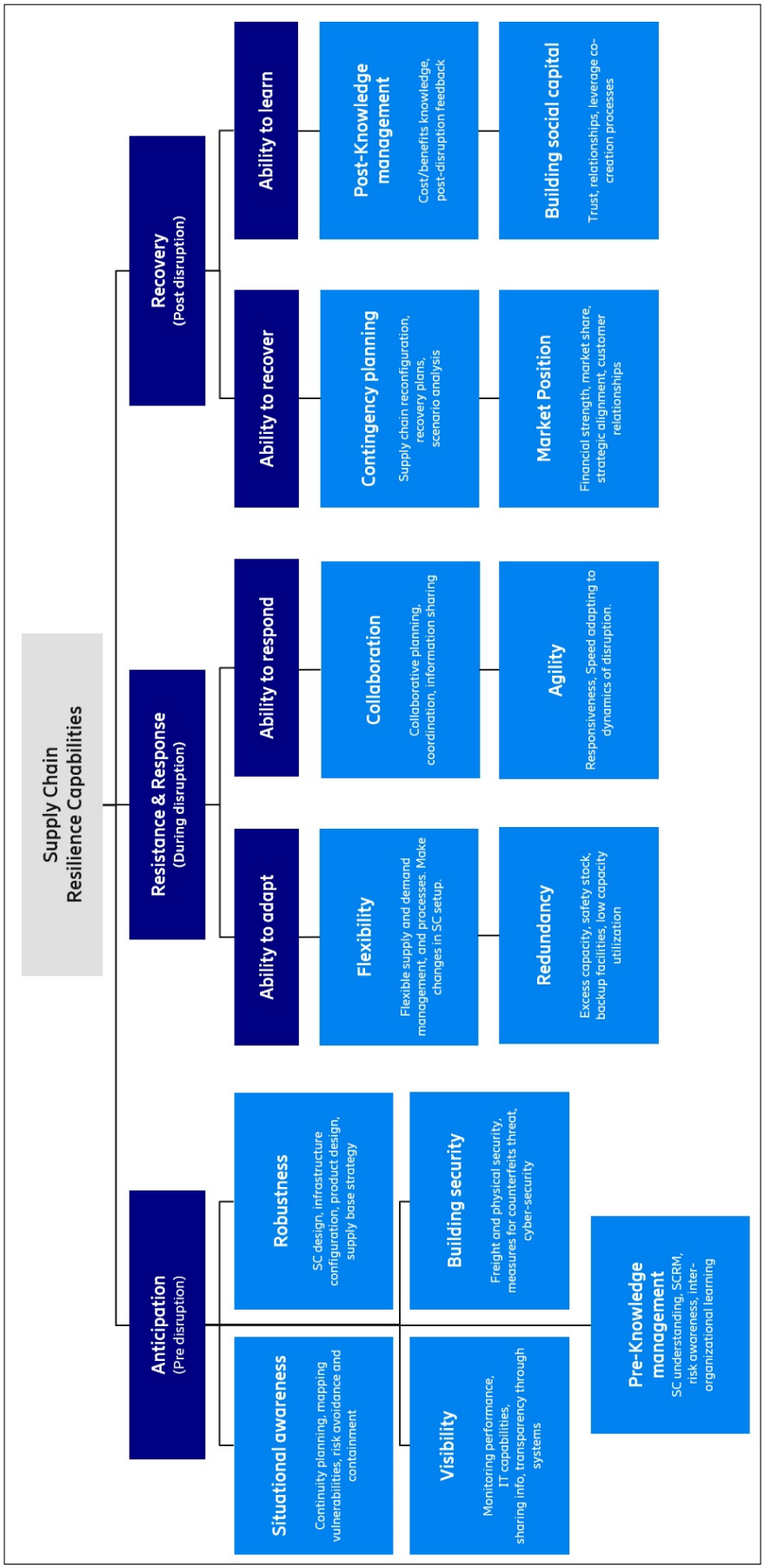

Figure 2.5: SCRES Capability framework adopted from Ali et al. (2017).

The content of each capability relevant to each stage of disruption is a compound of research done in the area (Ali et al., 2017; Tukamuhabwa et al., 2015; Melnyk et al., 2014). The presented framework is later on used as a way of structuring the findings of the empirical data.

2.3 Supply Chain Planning

Supply chain planning can be defined as *"the process of gathering information from buyers and suppliers to help the company plan its future actions and satisfy the demand at minimum cost."* (Paiva et al., 2014, p. 406). It is an outlooking process of organizing supply chain resources in the best possible way; to enable the delivery of goods and services from supplier to the customer, while balancing the supply and demand. Thus, the orchestration of several planning activities such as supply planning, production planning, demand planning and inventory planning (Gartner, 2022). One of the overarching planning processes aligning these plans is sales and operations planning, which will be described in the following section.

2.3.1 Sales and Operations Planning

Sales and operations planning (S&OP) is a well-known business management process that can be found in many organizations (Seeling et al., 2021). As companies face turbulent markets, uncertain economical environments, globalization, and increased supply chain complexity; companies have to put more and more focus on their supply chain processes and supply chain planning. This has led to the S&OP playing a more central role in many companies as its function is to coordinate and integrate these functions (Seeling et al., 2021). Authors define S&OP in various ways, one definition is by Jonsson and Mattson (2009). They present it as a process that occurs at the top management level with the end goal of creating and establishing plans for sales and upcoming production. The overarching purpose of the process is to balance supply and demand; this is done, as previously mentioned, by aligning cross-functional business decisions. S&OP further provides an opportunity to align the demand and supply with vertical goals; business strategy, operations planning, and execution as well as the horizontal supply and demand plan across the functions (Wagner et al., 2014; Jonsson et al., 2021).

Dittfeld et al. (2021) presents a conceptualization of the S&OP process, dividing the process into two parameters: set-up and process parameters. The set-up regards the level of detail, the interval between cycles, the horizon, and its planning levels. The planning horizon of the process varies but a common span is 3-18 months (up to 36) that is performed every month with a month-to-month focus (Wallace & Stahl, 2008). Process parameters are inputs and activities performed. Examples of input are demand forecasts, maintenance plans, production capacity, and desired inventory levels (Wagner et al., 2014). Recurring activities are demand reviews, supply reviews, pre-S&OP, and executive S&OP (Wallace & Stahl, 2008). The adaptations of the parameters differ between industrial contexts depending on elements such as dynamic complexity, detail complexity, and organizational charac-

teristics (Kristiansen & Jonsson, 2018).

Dittfeld et. al (2021) presents different focuses of the S&OP depending on the environment the firm operates within. The focus depends on the constraint that is experienced; companies that see their capacity as their main bottleneck, focus on optimizing the use of capacity. Others are material-supply-focus and demand-focused design variants. An additional S&OP parameter is the multiple planning levels that are encountered in different variants; where companies operate and include levels such as global, regional, and business groups.

2.3.1.1 Reactive and Proactive Measures of S&OP

Dittfeld et al.'s (2021) case study presents examples of companies implementing adjusting measures to changes in their business environment, both reactive and proactive. Reactive measures are divided into two; adaptations of the planning through the implementation of a crisis S&OP meeting, and a temporary adaptation of the S&OP horizon. The purpose of the crisis version is to quickly deal with an incident of severe impact, disrupting the chain, such as a plant breakdown to quickly sketch down the current situation and formulate a new plan. Dittfeld et al. (2021) further found companies adjusting the planning horizon of the process. In the study, legislative changes prevented a company from identifying and assessing long-term risks and thus made it difficult to make adaptations in their product portfolio. The legislative changes led to too much uncertainty in the outlook. Due to this changes in the horizon were made until internal issues and the legislative issues had been resolved (Dittfeld et al., 2021).

Proactive measures are also a big part of the S&OP; where risk identification and monitoring are key activities. Depending on the focus of the S&OP process, they are realized differently. A common denominator is the re-occurrence of meetings regarding the focus with threats to the focus area (demand, supply, and capacity) being brought up and reviewed throughout the process. Some companies perform risk monitoring through questioning and evaluating previous plans' performance to pick up early deviations between the planned and realized performance.

3
Methodology

In the following chapter, an overview of the research's methodology is presented as a start. It is further divided into four chapters consisting of the research strategy, data collection with observations, case selection, and interviews. The collection of data is followed by the analysis methods used and lastly an evaluation of the research's quality.

3.1 Overview of the Methodology Process

The research's first phase, pre-study, consisted of four elements; exploration of the subject, onboarding meetings, defining scope, and methodology research. As the research began, the subject area was in focus. Different articles, both academic and business-oriented, previous master theses as well as books, were studied to create an overview of the subject. Parallel to this, several onboarding sessions were arranged by the case company Ericsson, giving the researchers an overview of the organization and current practices. As the authors had been familiarized with past research, qualitative research, context, and goals of involved stakeholders; a relevant problem description was formulated. The scope of the project was formulated via an iterative process. A proposed scope was presented and revised back and forth until approved by all parties, including both representatives from the case company and the supervisor at Chalmers. With a foundation built up in the pre-study and the formulated focus of the project, the literature study was performed laying the foundation for the research. As the project proceeded additional changes were done in the literature, dependent on the maturation of the thesis.

As the literature foundations of the thesis were completed, the project moved on to the next phase; interviews. The interview objects were selected via a discussion process with the supervisor and stakeholders at Ericsson where the authors came up with input on what areas might be of interest. Included was a presentation of different types of disruptions as seen in *Figure 2.2* together with the SCRES framework found in *Figure 2.5*. Relevant individuals being a part of the teams resolving a past disruption were interviewed. The interesting subjects to be investigated were Ericsson's abilities in anticipating, reacting, and resolving disruptions (see more in *Section 4*).

In parallel to the interviews, the authors read into the different planning processes that the subjects are a part of via documentation available on Ericsson's internal

databases. The gathered data was then analyzed to finally be validated with involved stakeholders; based on these input factors conclusions could be drawn and the research questions could be answered.

3.2 Research Strategy

The thesis has been carried out using a qualitative research approach; the data used to provide insights have been of the descriptive and conceptual kind collected through interviews and observations. Bryman and Bell (2015) presents three common approaches to a research project; inductive, deductive, and abductive approach. The inductive is described to have its foundation in empirical data extraction that through analysis eventually ends up in a theoretical model based on the findings. The deductive on the other hand proceeds from available theory, which is then tested via hypotheses on the real-world application of the theory. Bryman and Bell (2015) describe the abductive approach as a combination of both the deductive and inductive approaches. According to Awuzie and McDermott (2017), the method allows for back and forth movement between the theory and data; to develop new or modify the existing theory. As the ability to provide answers to the research questions are much dependent on the acquired information from the interviews an abductive reasoning approach is used. Dubois and Gadde (2002) further cement the abductive approach to be appropriate as it tends to be beneficial whenever the study's goal is to discover new things and of being of an explorative character. The practical implication that the approach had was the development of the theoretical framework.

3.3 Data Collection

To be able to fulfill the project's aim, four sources of data were used, divided into two types; primary data and secondary data. The primary data was collected via interviews and observations. The interviews were conducted with Ericsson employees with involvement in their disruption work. The observations were of two types; direct and participant. Secondary data was collected through a review of internal documents.

3.3.1 Observations

To build a foundation of understanding the topic and apply these in the setting of the case company, observations were done continuously. The observations have been of two kinds, direct observations of listening in to meetings and planning processes together with participant observations with an active role in questions and discussions. The project was initiated with the authors being a part of an 'Onboarding Program' delivered to new master thesis students, as seen in *Table 3.1*. The goal was to get an introduction to the case company, build an organizational understanding, and gain knowledge and insights into their operations and supply chain.

Table 3.1: Introductory lectures with different functions at Ericsson.

Introduction Topic	Date	Duration
SCM Organization & Strategy	2022-01-24	90 min
Capability planning	2022-01-25	48 min
Radio Operations	2022-01-26	34 min
E2E Demand & Supply Planning	2022-01-26	84 min
Innovation	2022-01-26	54 min
Supply Sustainability	2022-01-27	39 min
Transport SCM	2022-01-27	54 min
Microwave Operations	2022-01-27	59 min

As a complement to the direct observations that gave the authors valuable insights into Ericsson and its' supply chain, two additional participant interviews were conducted, see *Table 3.2*. These interviews had a goal of providing knowledge specifically to our thesis to connect the resilience work performed at Ericsson and the supply chain planning.

Table 3.2: Participant observations within supply chain planning processes.

Introduction Topic	Date	Duration
Business Continuity Planning	2022-03-10	50 min
Planning processes	2022-04-04	52 min

3.3.2 Case Selection

To see how the studied company works in practice and concretize the implications, it was decided to build up the empirical data of previous disruptions that have affected the company in a near time horizon. The decision criteria for these disruptions were decided in collaboration with the case company. It was concluded that the disruptions should have occurred within a two-year horizon of the thesis initiation. This to both avoid no longer relevant events due to: too many changes done organizationally, improvements, new business environment, and the number of potential interviews objects still in the firm, to name a few. Another factor was the type of disruption, as previously presented in *Section 2.1.1*. A goal in the selection cases was to provide enough width in respect to cover different disruptive types but also its presumptive orientation in terms of at what level the disruption was solved; operational, tactical, and/or strategic planning levels, to cover eventual differences depending on that dimension. In this report the operational planning level is referred to as month 0-3, tactical to month 3-21, and the strategic is from a long-term perspective.

From this, three cases were selected. The first, Case A, was a 'Supply-side disruption' where a sub-supplier had a failure and could not deliver. It was seen to be handled within the operational orientation and had a very low possibility to be anticipated. Secondly, Case B was a 'Demand-side disruption' that regarded high uncertainties of demand of a new potential customer. Due to various reasons, the deal fell through. With these two cases, the external parts of the supply chain network could be covered. The third and last, Case C, was a macro disruption, COVID, affecting the whole supply chain network. In this case the focus was on the focal company to cover the 'Internal node and links' as seen in the disruption framework. Here, a strategic and tactical orientation was identified in the pre-study. With these cases, a broad selection of disruptions was established, in regards to the ability to anticipate, type of disruption, orientation, and lastly the supply chain network context.

3.3.3 Interviews

To get insights from the different stakeholders involved in Ericsson's resilience work, several interviews were conducted. As the responsibility area and levels differed between the interviewees, several different interview templates were used to account for the differences. The framework presented in *Section 2.2.4* was used as a base in the construction of the interview template used in the case interviews. Whereas the other interviews (see *Table 3.2*) the template was constructed to lead the conversation towards the SCRES with a focus on the topic at hand. The templates can be found in *Appendix A*. To set the scene for all the interviews an introduction of our project was done before the questionings start, explaining our purpose for the interview and presenting the area of SCRES.

A semi-structured format was applied to leave leeway for the interviewees to contribute something unique to the research, while still maintaining a structure making analysis and categorization manageable. The authors recorded every interview session to ensure correct quotations and take-aways were captured, but also to validate what was said by the interviewees making sure that all parties are comfortable with what was said. The selection process of interview objects was done in collaboration with the supervisor and examiner.

Another strategy for finding relevant individuals to interview for the different cases where to use the technique of exponential discriminative snowball sampling as described by Etikan et al. (2016). This method is designed so that interviewees can recommend further valuable interviews to provide further insights, knowledge, and function of the specific cases. The authors further mean that the method could be valuable to find unknown interviewees that are not limited to the knowledge of the authors. However, this could steer the direction of whom to interview and can discriminate and exclude access to some interviews of the total population of interest. (Etikan et al., 2016)

To be able to understand the impact, consequences, involved parties, and planning contribution, a first interview was held with selected respondents for each case. These respondents were highly involved and were seen to have a good overview of the disruption. This led to further interviews as viewed in *Tables 3.3,3.4* and *3.5*. The introduction interviewee for each case started to present an overview of the disruption and give the authors insights into the disruptions timeline. The first interviewee then recommended objects to interview next, that had a connection to the case and insights into how it was mitigated. These interviews further recommended objects to interview. The number of interview objects was decided based upon three factors: whether the authors saw a saturation in new information gathered from the interview objects, if a role with a respective function had already been interviewed for the respective case or if no new objects were introduced. The following tables present the different interview's performed in the respective case. The interview objects are hereon referred to via the number presented on the left side of the tables, in *Section 4* and *5*.

Table 3.3: Interviews in Case A: Supply disruption with role description.

Interview	Role Description	Date	Duration
1	Head of Planning and Communication	2022-03-07	29 min
2	Global Material Manager	2022-03-18	45 min
3	Sourcing Category Manager	2022-03-16	20 min
4	Strategic Sourcing Manager Electronics	2022-03-22	31 min
5	Global Material Coordinator	2022-03-16	38 min
6	Manager R&D	2022-03-28	31 min
7	Supplier Operations Manager	2022-03-29	41 min

Table 3.4: Interviews in Case B: Demand disruption with role description.

Interview	Role Description	Date	Duration
8	Head of Demand Planning	2022-03-08	26 min
9	Demand Planner	2022-03-15	33 min
10	Head of Sales MNEA	2022-03-18	38 min
11	Business Development Manager	2022-03-18	38 min
12	Global Technical Capacity Manger	2022-04-04	49 min

Table 3.5: Interviews in Case C: Macro disruption with role description.

Interview	Role Description	Date	Duration
13	BCP Driver of Supply	2022-03-08	27 min
14	Head of Inbound	2022-04-12	42 min
15	Head of Supply Hub Europe	2022-04-04	49 min
16	Head of Supply Logistics and Planning	2022-04-07	38 min
17	Head of Networks Planning	2022-04-19	45 min

To start, the two first cases, A and B, were done simultaneously, whilst the third case, COVID, was done sequentially afterward. This was done to be able to keep the focus on the different cases and process the material immediately. A further benefit was that learnings from the first cases could provide insights into interview techniques and evaluation of the interview questions.

3.3.4 Literature Review

The literature review consisted of three phases; pre-study, the building of a theoretical framework, and lastly complementary literature based on new implications from interviews. The literature was mainly found via traditional research databases such as Chalmers Library Database, Google Scholar, and Science direct, but also based on searches on Google when business articles were sought. Example search words were: supply chain resilience, supply chain planning, Supply Chain disruption, etc.

3.3.5 Documentation

As a complement to the interviews, internal documents provided via the case company's intranet were used both to validate the given information on the interviews and also to build up knowledge preparing the authors for the interview sessions. Examples of documents studied were process descriptions of the S&OP process, to build up an overarching knowledge of the ongoing activities. Internal documents covering the case disruptions were also looked into; such as pre-S&OP, S&OP material, Business Continuity Planning (BCP) frameworks, material analysis, demand planning feedback sessions, etc. This was to both verify timelines and get further insights in discussions while the disruption lasted.

3.4 Data Analysis

The data gathered throughout the project were primarily of qualitative type. The primary intake of data came from interviews of the focal company's employees. All interviews were recorded, and thus also rewatched in case important aspects of the interview were missed during the initial noting, an initial content analysis. The goal of the content analysis was to thematize the information gathered and at

an early state determine what research questions, literature or potential discussion points the content was related to. When this was done, the authors evaluated whether more data was sufficient to answer the research questions properly. If it was not, the data collection continued, interviewing more employees. As the qualitative data set acquired matured, the data was thematized into the theoretical framework categories. Key data segments connected to the questions and theoretical framework, respectively, were noted individually and then discussed. When these were concluded the relevant data gathered resulted in content produced for the report, building up *Section 4* and *5*. The cases were regarded as their own entity, this to capture their uniqueness but also the commonalities between the cases. The cases were thus analyzed individually as a within-case analysis. To further validate and develop the findings in the individual cases an analysis was performed between the cases, cross-case (Mills et al., 2010).

3.5 Research Quality

To evaluate and ensure the quality of a report, the concepts of research validity, reliability, and ethical approaches should be considered (Bryman & Bell, 2015). These aspects have been carried out throughout the qualitative research and will be described and discussed in the following chapter.

3.5.1 Validity

According to Bryman and Bell (2015), the validity of a report is divided into two categories, internal and external validity. Internal validity refers to the conclusion and findings being relevant to the gathered data. It is therefore most relevant in the data analysis phase (Yin, 2009). The interview questions were discussed and reviewed with both the case company and supervisor to make sure that the answers would give relevant answers to increase the internal validity of the qualitative research. The insights received from the interviews were shared with the supervisor at Ericsson and the supervisor at Chalmers to discuss the data found and the relevance for the study. The external validity regards to if the findings can be generalized beyond the scope of the research (Bryman & Bell, 2015). The study has been limited to the Group Supply department at Ericsson. The study could to a certain degree be generalized to actors active in the same sector, but to a lesser extent to actors in different industries. The found areas of improvement were general, they can therefore be reflected upon and are believed to be applicable in other supply chain settings.

3.5.2 Reliability

Reliability of the research refers to whether or not the study could be replicated and if the results would be the same to a large extent done at a different time (Bryman & Bell, 2015). The research consisted of semi-structured interviews which led to the possibility of misunderstanding and differences in interpretation. However, at all

times was the two authors present to reduce and minimize the risk of misinterpretation. Clarification questions were sent to some of the interviewees; while analyzing the data to verify what was said during the interview. Further, all the interviews were recorded, which meant that the answers could be interpreted accurately and could be verified additionally. If the study were to be replicated, using the same framework as the basis, the authors believe that the data gathered would be of similar characteristics, thus coming to similar conclusions as the thesis focuses on historical events. Although, some of the activities can be argued for being placed in different capability panels in the framework used, leading to differences. The cases are previous disruptions and it is known by the authors that Ericsson might have improved their resilience work and that some capabilities might have been missed out from the interview data which could give different results.

3.5.3 Research Ethics

Lastly, ethics is an important aspect when performing research on the impact of people participating and the results of the research (Bryman & Bell, 2015). Ethics was considered throughout the research and includes privacy, harm to participants, deception, and lack of informed consent. To keep the privacy of the respondents, the names were anonymized, but the roles remained to contribute to the validity of the report. The purpose of the research together with how the answers were to be used were told in advance of the interviews. All interviews were recorded and the interviewees were asked for permission to give their consent. Finally, the report was sent to Ericsson and supervisors to be able to read the report in advance to assure that no sensitive or confidential information was admitted.

4

Empirical Data and Cases

In the empirical findings, the case company is first presented with a quick overview of their supply organization, how the planning process is set-up, and its connection to SCRES. Secondly, the three chosen cases will be displayed. The first two cases, Case A and Case B are categorized as "Internal supply chain disruptions" as previously presented in *Figure 2.2* in *Section 2.1.1.* The third case is a "Macro supply chain disruption" according to the framework. The empirical data provided from the interviews in the cases are categorized into sections of the framework by Ali et al. (2017) to create a consistent structure. At the end of each chapter, there is a summary of the resilience capabilities found in the cases.

4.1 Introduction to the Case Company

Ericsson is a Swedish multinational ICT company, with its headquarters in Stockholm. The company provides the market with infrastructure, software, and services in the ICT area. Its product portfolio is divided into four business areas (BA): Networks, Digital Services, Managed Services, and Emerging Businesses. Networks, the area making up most of the company's sales (approx. 70 percent), revenues and accounts for most of the products produced and delivered (Ericsson, 2022). Within the business area, there is a unit called Group Supply, responsible for Ericsson's supply chain management (SCM) for the four different BA's. A part of that organization is Networks SCM, responsible for SCM activities of the three underlying product segments: Radio, Transport, and Microwave. The tactical horizons of the departments are divided up into two; with product-specific SCM Operations teams handle the short-term horizon (0-3 months) while the cross-functional teams generally focus on a long-term horizon (3+ months). One of those teams is Network planning.

Network Planning plays a major role in Ericsson's global planning process, which is performed in collaboration with other functions of Ericsson. The process is done in cycles and starts with the market area collecting information from the customer units in the region. That leads to data and information such as demand plans, supply plans, and issues fed into the S&OP decision process on a market area level. The different markets' proposed demand for the upcoming planning period is then aggregated by planners on a higher abstraction level. This is then fed to the whole business area's S&OP decision meeting as three proposed global demand scenarios; conservative, proposed, and stretch. The decided demand plans are then balanced

with current supply capabilities and complemented with input from various departments such as financial, product development, etc. These plans fall into two global plans, a global material plan, and a production plan. The global material plan is handled by the Inbound organization, while the production plan is divided up into two strategic focus areas. Short-term plans are handled by one organization and long-term issues by the planning division. In the long term review, issues such as potential capability issues, inventory health, as well as capacity in the manufacturing sites. The analysis is then fed into the tactical dimension meeting where decisions are taken upon eventual investments required to secure future ability to meet customer requirements.

One of the teams within Network Planning that are highly connected to parts of the resilience work is the Capability team. They drive key strategy decision forums and release the global production plan. The decision forums they are responsible for are related to capacity and flexibility investments, inventory management, and driving changes in the loading of demand data into a collaborative system.

There are many ways of increasing a company's resilience. Some of the applied work within planning are capability flexibility that is proactively looking into future capability issues, KPI monitoring with planning scorecards of buffer levels, and production test flexibility. Moreover, internal BCP in the form of governance and process with agile process implementations, risk management adaptations, planning flexibility work, etc. The business continuity work is shown in their initiatives e.g dual production. Crisis meetings have been observed; where different crises are brought up and discussed e.g. Russia-Ukraine war.

4.2 Case A: Supply disruption - A sub-supplier failure

Looking into the disruption framework presented in *Section 2.1.1*, this case could be categorized as a supplier failure, the most uncommon disruption in supply-side events. The ability to anticipate disruption of this kind could be seen in *Figure 2.1* as an 'Unanticipated disruption' with 'None' to 'Days' ability (McKinsey, 2020). As other disruptions, such as COVID-19 and semiconductor scarcity, played in it was described as the 'perfect storm' (2).

The case started in the fall of 2020, when a semiconductor sub-supplier, hereon referred to as Alfa, suffered from an unanticipated failure. Alfa is a sub-supplier that supplies many of Ericsson's, then, Tier 1 suppliers (2). Alfa produces a large share of the global market demand for these components, creating difficulties in finding sourcing alternatives (4).

The incident caused damage for a total of three days and damaged the plant severely, thus affecting the supplier's ability to produce. In Q4 2020, customers received official information that there was a need to switch to alternative products or find

another supplier, and that production was not to be resumed for at least well over one year. About half a year after the incident, the sub-supplier sent out official information that the failure was still under investigation. This shows the complication of this type of failure, and also how long it can take until the full impact and consequences can be confirmed.

For Ericsson, information about the disruption was retrieved from one of their suppliers, who had Alfa as their main supplier (2,4,7). Later on, they received information from the news as well. When the information was retrieved, Ericsson contacted their suppliers who used the Alfa to know how the impact of the failure would affect them (1). The Inbound team sent out email midday six days after the start of the failure to the affected parties at Ericsson who needed information to assess the potential impact it could have. Since it was a sub-supplier, it was trickier to receive this information quickly (1). Already then, extra material had been ordered to build buffers for some potential components identified (1). Later in the afternoon, another email was sent out, where two out of five suppliers had evaluated a brief impact on component-level (1,5). In this, a list of affected components was included. About a handful of them were single-sourced whereof two of them had less than 10 weeks until impact, while e.g. Microwave Operations had a few critical components (5). The affected finished products were also included to know how they would impact the deliveries to customers. (1). On that specific day, one part of the Inbound team received 25 emails on the subject alone (1). However, as stated in one interview, it is sometimes hard to understand the impact of a failure of this type and how long it will be affecting the supply chain flow of goods (2). Further, it was difficult to know the plans of Alfa on what strategies they would pursue, resume, or move production elsewhere (2,7). Almost one and a half years after the disruption, no decision has been made on whether or not to rebuild the old factory or pursue an alternative.

The day after, a quite extensive component-level impact overview was established (7). Information on the components sourcing availability, status if single- or multi-sourcing was applied, together with a potential available second source of components, and which sub-supplier was used. Furthermore, information on when the component would have an impact on the production. With this, a risk analysis was presented by supplier management within Inbound. The resulting analysis was a scale from 'High+' to 'Low', on how the component could affect Ericsson's production. The risk analysis of the components was dependent on the weekly updated status. The condition of the component derived from whether the status had changed, either from new sources from suppliers, increased buffer level available, and/or alternative design changes developed by R&D (7). From this information, teams and individuals could see which components were the most critical to manage.

Followed from the information presented, sourcing booked meetings with five suppliers. The goal of the meetings was to describe, request, and gather the data needed as input for Ericsson to get a sufficient overview. The suppliers were given a time frame of one week to provide this data (4). The data included an additional analysis of alternative solutions and eventual buffer capacity to give Ericsson the complete

picture of the disruption (4,7). The disruption was a recurrent subject in meetings for roughly half a year afterward (2). At present time, this disruption is still affecting Ericsson, though on a smaller scale (4,5).

4.2.1 Resilience Capabilities found in Case A

The following sections describe the different capabilities applied throughout the supply-side event. In regards to resilience capabilities, several panes from the framework can be found in the mitigation belonging to this disruption.

4.2.1.1 Anticipation

Interview objects identify two enablers to mitigating a disruption like this; the connection Ericsson had built up with its suppliers and the person working as an escalation point between suppliers and Ericsson. Through this it is known whom to contact in case of disruption from both sides (1,2). The connection is further seen as a complement to receive possible 'soft information' together with forecasts used in the weekly internal meetings to enable adaptation accordingly (2). This could be seen as part of their situational awareness. It is explained that there needs to be a built trust between Ericsson and the suppliers to help with disruptions. Good relations with suppliers is said to be necessary when coming out of disruptions, both in terms of eventual prioritization but also in terms of information, speed and quality of it. However, with a deeper connection to a sub-supplier, the burden of taking care of issues could be shifted from the supplier to the focal company (2,3). An interviewee believes that Ericsson could have been even more aware of their different tier 1 suppliers' dependency of a tier 2 supplier, to be better prepared or even prevent eventual effects of the disruption (2). Another activity was how they could actively help their suppliers find new sub-suppliers through their supply chain network by sharing information (2,3) and working proactively on a longer horizon (3). Experience and the know-how to deal with disruptions have been built up from similar previous disruptions (1,2,4,5).

There are several processes and tools established at Ericsson that help them increase supply chain visibility. An internally developed tool used was a digital geographical map where Ericsson's suppliers and their factories are mapped out (3). This enables simplified visibility to know the impact of different geographical events e.g. earthquakes, tsunamis, or geopolitical issues. However, this did not help in this case since the failure hit a sub-supplier. This was seen as an area of improvement but was considered complex to solve according to an interviewee (3). It is further highlighted that there is a need for supplementary mapping of ingoing components (sub-components) to understand the supply chain, but there is a lack of good support to implement this (3). In addition, this was noticed when another sub-supplier had a disruption of a similar kind (3). A further way of receiving information to provide visibility was the use of the external company Resilinc. Inbound, among other teams, use it for alerts of different disruptions that affect the supply chain, making it easier to get a quick understanding of issues and potential impacts in the supply chain (2,14). However, this was implemented afterward and could not be

used in this case (2).

A specific redesign process existed in R&D where products are assigned whenever redesign is required. If a product needs a redesign, it could easily be added to the processes. This was seen as a key enabler in redesigning activities and changing components to find solutions to the remaining component issues (6).

4.2.1.2 Resistance & Response

To mitigate the direct effects of the disruption, Ericsson's capabilities in responsiveness and ability to adapt were used. Ericsson aim to have high flexibility, but in this case, it was found difficult because the suppliers used the same sub-supplier(4). Sourcing and the Product Development Unit (PDU) therefore looked for alternative sourcing (5). R&D took the role of finding replacement alternatives for the remaining impacted components that did not have a secondary source. Either through switching components completely to another or via redesigning the components (6).

The difficulties in anticipating the disruption, and that it would affect other suppliers in the base, lead to Ericsson having to rely on built-up resistance capabilities. Ericsson already had quite high buffer levels with excessive capacity built up from the strategy execution derived from COVID-19 mitigation strategies. This was seen as crucial as it could postpone the disruption's impact; giving Ericsson time to find alternative solutions and redesign components before it impacted the production (2,6). Additional buffers were recognized as a further improvement according to the interviewee (7). Even though they had buffers, all available components were bought through the process of Last-Time-Buy (LTB) (2,7). Afterward, they switched to another supplier and worked on building up more capacity, to increase the buffers further (2,7). One supplier produced these components partly in-house which enabled them to buy more from this specific supplier, as they were not as affected as others. The speed of acquiring that capacity was thus of high importance. Additionally, there was a check of what was in stock in different hubs together with if there were any incoming goods in transportation to further assess the criticality of components (5).

With a disruption of this magnitude, collaboration was seen as a necessity when approaching different mitigation strategies. To quickly align information and update Ericsson's affected teams on the development of the disruption, a task force was created. This is a relatively standardized process that is triggered disruptions emerge (14). The task force was not implemented until a united and clear understanding of the problem was established, to know how it would affect Ericsson and the degree of impact (4). It included Sourcing, Inbound, Supply, and R&D to cover all parties involved that could continue to deliver and align information to solve and mitigate the disruption (1,4,7). Further, product owners were involved in the solutions found, to verify the changes to assure the product requirements are fulfilled (4). The task force monitored how the disruption evolved and updated the component statuses continuously and how it would affect the production plan. Mitigation strategies were formed, executed, and communicated to affected employees

(4). Nonetheless, employees at Ericsson state that they spent a lot of time and resources to make it work and overcome the disruption (2,7). It was considered complicated to know whom to contact since the information should only be sent to people who need the information in order not to create additional problems (1). The implications and impact the missing components could have on Ericsson could have been emphasized better in their communication with suppliers. Instead of only laying purchase orders, additional information could provide the suppliers with a better picture of the situation. This could potentially have speeded up the reaction from the supplier's side (2).

The cooperation and collaboration between the teams were seen as good according to interviewees 4 and 7. The component group was quite specific, which limited the number of people involved. The people involved knew each other from before which made it easier to collaborate (4). However, this was not agreed upon by all employees involved. Employees 5 and 6 on the other hand argue that the information shared was unclear, occasionally delayed, and that too many people were involved. Employee (6) believed that the incorrect persons were involved at the beginning and that information received from suppliers and different parts of Ericsson differed. The interviewee further believed that due to this, too many hours and resources were spent on the disruption mitigation than needed, making it inefficient (6). Almost one month after the failure, employee (5) estimated that a good and clear picture of the problem was established. Then, when all information was in place, they could more calmly and structurally handle the disruption (5).

Another capability applied in the disruption was agility; the responsiveness and speed that mitigated the impact. It is commonly agreed that the quickness of action is critical when handling a disruption like this (1,2,4,6). Without the speed, other actors would get the excess material from suppliers and find alternative solutions to the problem before Ericsson (2,4). From many of the interviews, it can be concluded that they believed it was handled well and that they had a quick response (2,4,6). The agreed factors contributing to this quickness are the established know-how and the task force. Sometimes it can be difficult to stress the importance of the disruption and how long it might cause a disturbance, both towards suppliers and towards different parties at Ericsson (4). Despite this, all parties were not involved as quickly as they believed they could have been (6). This could have been since there was no existing process on how to handle disruptions of this kind for R&D; in comparison to how it is presently (6). It could further be discovered that there was not a standard procedure for this disruption, according to one interviewee. They rather did it by adapting to the dynamics of the disruption in an ad-hoc fashion (2).

4.2.1.3 Recovery

To recover from the disruption, action plans were formed to handle the affected components, as previously presented, in a high-low risk analysis that derived from Inbound and Supply (5,7). A new process was implemented after the disruption. This was due to the component shortage affecting the world in general e.g. semiconductors and thus not a direct outcome of this disruption. The process consists of

weekly meetings where the most critical components are discussed and actions are formed. That process could have improved the mitigation actions performed in this disruption (5).

Ericsson believes to be performing better than some companies in handling disruptions and has even taught other firms how to handle disruptions more efficiently (2). This is derived partly from the experience built from previous disruptions which have led to the believed competitive advantage (2). An explanation arguing for this could be that Ericsson has managed to keep the deliveries to their customers, which have in turn led to a gain of market shares (2,4,6).

According to a interview object there was no post-disruption feedback created and communicated to the respective parties (5). Though, this has been made for some other disruptions. None of the other objects mentioned the utilization of a feedback session. Before the disruption, one interviewee stated that it was not clear how important Alfa was as a tier 2 for all tier 1 suppliers. This has been changed and their knowledge has expanded for the specific components affected by this disruption (4). The spread of this information throughout the organization is unknown.

In the area of building social capital, it was found that R&D could play a bigger supportive role, in disruptions of this type (1). It was said to be hard to communicate the urgency; to prioritize between components being affected by different disruptions (2,4). It was mentioned to be difficult to know the prioritization, especially if the area is outside your field or scope (4). This made it harder to communicate and collaborate (4). Sorting these issues, a good and clear picture could have been established earlier, even though it is important to give people time to get hold of the correct information (5).

4.2.2 Summary of the found capabilities

The following table summarizes the found capabilities connected to case A.

Table 4.1: Resilience capabilities in Case A sorted into the capability framework.

Anticipation	Resistance & Response	Recovery
Situational awareness	Flexibility	Contingency planning
• Good relationship with suppliers. Soft information sharing.	• Multisource alternatives. Actively helped suppliers find new sub-suppliers through their own network. • Redesigning activities	• Action plans based on the risk analysis of criticality
Increasing visibility	Collaboration	Market position
• Tool for sharing information on disruptions that happens in the world with push notifications. • Geographical mapping of suppliers	• Cross-functional taskforce • Information distribution continuously	
Robustness	Redundancy	Post-knowledge management
• Process set up for enabling component changes with R&D.	• High buffers from COVID strategy • Building supplier capacity and redundancy	• Gained knowledge about lower tier suppliers' importance for tier 1
Building security	Agility	Building social capital
	• Quick reaction • Ad-hoc approach	• New process of weekly meeting discussing the most critical components
Pre-knowledge management		
• Experienced employees in handling similar situation		

4.3 Case B: Demand disruption - Uncertain demand

This case is categorized as a demand disruption (see *Section 2.1.1*). A big demand was for a long time anticipated but due to what could be seen as unforeseeable events dropped.

The disruption began as one of the biggest operators in China was going to invest in a new frequency band. To Ericsson, the product specifications were new as well as the customer itself, and the demand was considered big. As the lead times of ingoing components were longer than the customers' expected lead time, investments had to be done before contract signing (8, 10). This led to a process where investments were carefully considered and reviewed in a structured cycle (8,9,10,11,12). Having to invest before a deal is not unique; though aggravating factors come into play making the situation complex. The factors derive from product characteristics, supply lead time, the customer, as well as geopolitical conflicts. The product characteristics that affected were the number of components identified as unique for this project, thus not usable in other orders. Supply lead times had been extended, due to various reasons. The customer also brought in complications by changing the specifications of the product and postponing the project start several times. The final factor was the geopolitical landscape, where a decision by the Swedish authorities to exclude Chinese manufacturers from participating in bidding came to have a drastic impact.

The geopolitical issues derive from Swedish Post and Telecom Authority (PTS - Post- och telestyrelsen) that together with The Swedish Armed Forces and Swedish Security Service (SÄPO) concluded that a Chinese telecom actor was not allowed to participate in the bidding of constructing the 5G network in Sweden (8). The affected manufacturer was looking at the matter differently and started a legal process (Ahlander & Mukherjee, 2021). This dispute began in 2020 with PTS's decision finalized of exclusion by the 20th of October and was fought legally throughout 2020 and parts of 2021 (Sveriges Domstolar, 2020). After a long dispute, the competitor was by the 19th of January 2021, according to the Swedish court, lawfully excluded from the bidding (Söderpalm & Mukherjee, 2021). The potential backlash on Ericsson from this decision was long taken into consideration, but predicting the repercussions was difficult, as proven in this case.

The deal was revealed in December of 2020 in Ericsson's S&OP cycle where the potential demands of the different market areas are forecasted and brought up. It was quickly realized that the number of project unique components that were required to fulfill the potential customer's demand was many. As the sales department presented uncertainties in the deal, it was early on classified internally as a supply chain breaker, due to the deal's uncertainties and potential effect on the supply chain. This meant that the deal was brought up and discussed in a cyclic format in Ericsson's S&OP; from the account level up to the central business area S&OP meeting. In the S&OP meeting, participants made decisions on how to proceed with

the commercial risk scenario. During the meeting, data gathered from different functions of the market area were presented in the form of contextual facts regarding the breaker, key assumptions done in their estimations, forecasts presented by the market area, and the demand planning function. The focus in these decisions was the business implications driven by the investments in unique components coming into the deal. The metrics presented were investments done to the date of the specific meeting, proposed investments required for that period, and also different future required investments based on forecasted scenarios (market area, demand planning team) (8).

The market area presented a large uncertainty of the demand in the upcoming planning cycle during Q1 of 2020. This led to demand planners zeroing out the demand for Q4 and only loading the demand for Q2 and Q3. When this information reached the business area level, the executives took a higher total decision than the market area recommended (8, 9). This was said to be done due to known lead time issues, and prioritization of being able to deliver according to customer demands rather than standing there without being able to deliver.

As the dispute between the Chinese competitor and PTS unraveled, which Ericsson monitored and evaluated every week, Ericsson realized a potential backlash from the Chinese government. The expected consequences of the dispute were expected to be somewhere between an expression of disapproval to excluding Ericsson from the Chinese market (8). While this went on, the customer kept pushing the date of delivery and hand-out of market shares. This led to a waiting and monitoring game, trying to be as prepared as possible for when the need was to appear again. After some time of monitoring the situation, the consequences appeared slowly and Ericsson realized they most likely would not receive the expected amount of market share. A ramp-down of loading components was then executed gradually, with similar reasoning, as being able to deliver if the deal were to continue as previously expected was prioritized.

A request for proposal was sent out by the network operator at the end of March 2021. Before the request, a test of the manufacturers' offerings was done, resulting in a performance score. The score was the foundation of the division of market shares in the different lots given out by the operator. Regardless of a high score, they received less than anticipated (10).

4.3.1 Resilience Capabilities found in Case B

The following sections describe the different capabilities being applied throughout the demand disruption case. The defining moment of disruption depends on how you look at the situation; it could be one of the geopolitical decisions being made throughout the deal's build-up, or when the operator presented the shares of the contract given out to the network manufacturers. We have defined the time of disruption as when the market share was presented to Ericsson. Due to this, the capabilities utilized in the case will be presented where Ali et al. (2017) placed them

in the framework, see *Section 2.2.4*.

4.3.1.1 Anticipation

The difficulties in anticipating the outcome of the deal stemmed from two sources; a new customer with unique and large volume demands, and previously mentioned geopolitical disputes (8). This led to a situation that had to be treated with care and was concluded to be difficult (8). Due to the dynamics, the deal was early on classified as a supply chain breaker, according to set policies, becoming a part of the S&OP meeting agenda (8). The focal company then focused on gathering information on the situation to create and spread situational awareness during the different phases by continuously sensing and interpreting the market (8,9,10,11,12). Data was gathered from the account responsible and then cascaded through the organization providing the rest of the organization with a picture of the latest updates daily or weekly depending on the information gathered (8,9,10).

Demand data was summarized and presented on different levels of abstraction; globally, but more specifically from the market area and account responsible (8, 9,10,12). Uncertainties based on the demand data were described and discussed among several roles, such as commercial responsible, financial controller, and product portfolio responsible. The outcome was demand scenarios for the upcoming cycle (9). These demand scenarios were then presented at the business S&OP meeting where decisions based on the information are taken. Examples of decisions would be ramping up or down the loading of material for upcoming periods (9).

Another aggravating factor in the case was the product design, which for a long period was uncertain and at the same time included many project unique components (8,10,11,12). Longer lead times on components forced the company to speculate on buying components (8,11). By early on involving the PDU together with SCM, they could at a conceptual stage estimate the cost of ingoing components to the project, as well as gain more information about the readiness of the product to be put into production (10,11,12). This was something that had not been done to the same extent previously (12). The required investments to fulfill the potential demand provided by the global demand planner was then considered in each cycle (9). This enabled early, adequately accurate cost estimates and readiness of the product. This leads to better opportunities for planning according to the current situation and making more informed decisions.

The sales department recognized early on the importance of involving coworkers with good product knowledge, and thus had a close collaboration with business development managers throughout the deal (10). These managers functioned as a supporting resource to the commercial function in taking decisions and springboard towards setting up the production plans (10).

4.3.1.2 Resistance & Response

The resistance and response capabilities utilized in the mitigation of the situation can be connected to all the panes found in *Figure 2.5*. To minimize capital at risk, postponement strategies were applied in production to minimize the number of modules with unique components. With the same intentions, speculative procured components had special features enabling them to be modified, making Ericsson resilient to order changes and enabling re-calibration to fit other projects. The flexibility of the production unit's planning, and ability to re-plan was put to the test as the start of production had to be postponed several times due to the customer delaying the need (11).

A task force was formed to cope with the issue (12). The participants in the team were the project manager (solution team), strategic product management, PDU, SCM, customer account, and demand planners. Other involved actors were the supply organization in the market area, and the BA responsible. Coordination of the different flows of information from each department was done through task force meetings and S&OP gatherings. Gathering information such as lead times on components, product readiness, and changes of components, as well as information from the downstream responsible, that were reviewing current market implications. These actors exchanged information on a weekly basis and fed information to the S&OP process(10).

Another strategy applied was the build-up of strategic inventory. This could also be seen as the risk that was built up, and in the end, backlashes. The strategic inventory was built up consisting of the components required to fulfill the expected order requirements of the customer (8,12). The company then adapted to the dynamics by addressing the parts that were unique to the project and thus made changes in their standardized process. These were separately calculated in an internally developed tool used to concretize the investments required and already committed, for each stage of the process where investments were needed (12).

4.3.1.3 Recovery

The post-disruptive capabilities identified could be connected to the ability to learn were knowledge management, and building social capital. None of the interviewed employees discussed a post-disruption feedback report other than internal discussion, further, no formal feedback document was found by the authors. An interviewee saw the benefits of excelling in the communication between SCM and the market area and commercial areas of the company during these situations as this enabled quicker mitigation of eventual capacity gaps. This is something that is now applied in their day-to-day business (12).

Involved management and employees credit the approach of monitoring project unique investments that enabled an overview of the current and future risk exposure in a structured and periodical format (8,12). This format is said to be used in similar scenarios in the future (8,12). An enabler of the investment overview

was the developed inter-organizational relationship between the PDU and the SCM team, as described in *Section 4.3.1.1*.

Recovery plans are a part of this phase of disruption, but there were difficulties in doing anything about the remaining problem once the decision was made. Efforts in utilizing unused materials were applied, though not with success when it came to the project-specific material (10). One can say that contingency planning was done before the disruption when the risks were identified and discussed. It is therefore filled in the summarizing table.

4.3.2 Summary of the found capabilities

The following table summarizes the found capabilities connected to case B.

Table 4.2: Resilience capabilities in Case B sorted into the capability framework.

Anticipation	Resistance & Response	Recovery
Situational awareness	Flexibility	Contingency planning
• Continuous sensing and interpreting • Data summarized and presented at different levels. • Vulnerability realization	• Flexible demand processes, production and scheduling • Postponement of production • Reconfigurable components	• What if scenarios were considered throughout the process in decision points.
Increasing visibility	Collaboration	Market position
	• Cross-functional taskforce • Tight collaboration between PDU, sourcing, MA and commercial	
Robustness	Redundancy	Post-knowledge management
• • Special process handling demand decision's implication on SC.	• Build-up of strategic inventory	
Building security	Agility	Building social capital
	• Introduced new process due to high-risk exposure • Adapting to changing customer needs	• PDU involvement • Improved communication with MA and Commercial
Pre-knowledge management		
• Experienced in handling similar situations		

4.4 Case C: Macro disruption - COVID-19

The last studied case is categorized as a Macro disruption, it is thus not an isolated function of the case company's supply chain that was affected. This led to mitigation actions that induced collaboration between the departments.

COVID-19's first implications were seen in early 2020 (Jan 17). Ericsson saw the outbreak's potential to affect them after a geographical analysis of their exposure in the Wuhan area, evaluating suppliers, buffers, sourcing strategies, etc. (14). As mitigation actions to handle the local impact in the Wuhan area were in formulation, Ericsson discussed the disease's potential impact in March. The supply organization then took two rather critical decisions; the disease will have a global impact and will go on for years moving forward (13,14,17). This led to different strategic thinking when mitigating the pandemic situation (14).

Ericsson's supply division then started its work by setting up the organization for mitigating the crisis. They ended up with three levels of abstraction, with different focuses: strategic, tactical, and operational focus. The main component of Ericsson's strategic work was the formation of a COVID-19 BCP framework tailored to the specific crisis at hand (13,17). In the framework, Ericsson established a decision log and governance model; tracking, controlling, and aligning the decisions being made (13,17). They also analyzed outbreak scenarios to understand macro economical impacts to then be broken down into demand scenarios in the market. The countries were divided into two governmental approaches to mitigating the disease, building up herd immunity, and lock-down of countries. Furthermore, a breakdown was done of the supply risks (material supply, production, and logistics) exposed to (13). The identified demand scenarios and supply risks led to a list of action plans that were created to address these issues, with early indicators acting as triggers (13). Another important feature of the framework was the funnel system that guided decision-makers to break down and look at the issues at hand in a systematic way.

A part of the mitigation strategy was to set up new meetings. Leader meetings with head representatives were held monthly focusing on strategic and long-term issues. (13,17). Processes were also set up to handle the tactical and operational horizons. Such as weekly supply and demand update meetings monitoring the day-to-day actions, and factory production meetings (17). There was a focus on aligning the functions initiatives and ensuring that the priorities set by involved parties were aligned and adhered to. The departments then worked individually fulfilling their part, in the form of action points (17). What actions were required to be able to fulfill the department's responsibilities were said to be localized and up to the department, thus enabling them to be independent and also take 'brave decisions' (16).

Communication and information control was set up early with a structured recurring process for meetings, having data ready and publishing it. This was done to ensure correctness and avoid unnecessary time spent chasing information or data.

Some departments also worked with limiting people adding respondents in a mail conversation, to make the information more targeted (17). The identified activities connected to the BCP framework are summarized in *Table 4.3* below.

Table 4.3: A summarization of the identified activities in the BCP framework.

BCP Activities	Short description
Decision log and governance model	A forum where decisions are logged, responsible are set out and comments about them are noted.
Contingency plans/outbreak scenarios	Planned for different outbreak scenarios; countries mitigation strategies to covid. The different supply risks were also considered, in their own sections, involving functionally responsible.
Funnel system	Breaking down issues in a structured way, applied in all supply risk areas.
Monthly leadership meetings	Discussing strategic outlook. Overview of the function's performance.
Weekly supply/demand monitoring	Operational meetings setting focus on what demands to prioritize and thus supply that is needed. Daily focus. Followed up on production, component issue.
Weekly Factory meetings	Following up on production in the different sites.
Activity and information controls	Setting days for preparing and publishing data, and meetings

An interviewee summarized their resilience efforts during this period by defining their four key areas of resilience; build-up of dual production capabilities, changes in sourcing strategies, changed buffer strategies, and the cross-functional collaboration with R&D engagement as a key collaborator (14).

4.4.1 Resilience Capabilities found in Case C: COVID-19

This section presents the capabilities identified in the interviews regarding Ericsson's mitigation actions against COVID-19.

4.4.1.1 Anticipation

COVID-19 initially had an impact locally, but as the situation developed Ericsson realized the impact it could have globally. This led to a decision where they internally classified it as something that will be global and affect them for a long time moving forward (13,14,17). Focusing on short-term solutions was seen as something that would bite back. To gain control, understand different disease outbreak scenarios, and possible supply vulnerability areas, and set a structure for the company's approach to the disease, a BCP framework was created (13,14,15,16,17).

Ericsson built up robustness proactively by acknowledging changes in the supply market, leading to a build-up of buffers (14). Another resilience measure was working on the possibility of dual production of a selection of products; enabling the pro-

duction of these products in more than one location (13). The risk evaluations also led to Ericsson reviewing its supplier base strategy, trying to avoid multi-sourcing setups where the origin country is the same. These actions could also be seen as a response. Robustness could also be found in the hubs that have their own BCP setup, as well as within logistics, where logistical agreements were in place with several providers enabling many alternative routes (16).

Learnings from previous events and a deeper understanding of the supply chain have led to risk awareness and a proactive mindset within the different departments. This has led to widespread BCP work within the separate departments. Simulations and scenario discussions were for example used locally in the supply hubs to discuss what-if scenarios.

4.4.1.2 Resistance & Response

The ability to adapt as COVID-19 came into effect, is shown in many different ways in their BCP framework. A way of increasing Ericsson's previous initiatives in building up and reviewing the current supplier setup. This was done by identifying components that were sourced from suppliers with only one country of origin, a new criterion of importance in this geographical crisis (13,14). A similar approach was used on important products that were set to have dual production sites. High-runner finished products were mirrored in the hubs, making a chosen portion of Ericsson's portfolio available on multiple sites. Another adaptive change was the changed component stock policy, with increased inventories in all market areas with some areas getting further buffers due to its considered importance (13,14). The region's strategy of mitigating the outbreak was also a factor playing in, as lockdowns could put factories and suppliers into situations where they can not produce (13).

In the planning and coordination of the functions, several actions were taken to adapt and respond accordingly. Limitations and fast changes in the supply chain sphere required coordination between the supply and production functions with the commercial function. Aligning and coordinating the actions of inbound, production, and logistics with the feedback received from the market areas was thus needed. This was done via weekly collaborative planning meetings; where for example prioritization of problems and customers was established. Responsibilities and action plans, connected to meeting these objectives were then handed out to the respective function (13,17). The execution of the plans was then followed up in the next scheduled meeting. Different types of meetings initiated were day-to-day supply meetings, weekly group leadership team meetings, and factory meetings. To fulfill the supply plans, new collaborations were stipulated to a new level between functions (14,17). Such as a business continuity team between R&D, supply, and inbound where sensitive products were considered when buffers weren't enough to reach sufficient resilience (14).

To handle the internal flows of data communication control systems were set up (17). Days for data creation and publication were set, as well as limitations on what information is to be sent out to a broad audience. The last-mentioned material was

instead gathered and sent together with other information (17).

4.4.1.3 Recovery

Recovering from COVID-19, and the different mitigation actions small and big disruptions it led to are difficult to pinpoint. A firm's ability to recover is much dependent on the contingency planning done, activities planned for in case of disaster. This can be reflected in the initiatives and abilities in supply chain and resource reconfigurations related to different scenarios. The contingency planning was done in the construction of the framework, which was followed up and updated as the pandemic developed. In this planning, Ericsson looked beyond the risks and saw opportunities; strategies for taking advantage of situations where competitors might lack the ability to deliver (13). The realizations of these opportunities were possible due to Ericsson's ability to reconfigure and remobilize supply chain resources. Such as moving products, flexible production, and having set processes for how to deploy production of a selected set of products at other sites. The scenarios were constructed and mitigation actions were formed to cope with the scenarios. Triggers for the actions were also developed (13). As the scenarios were planned for, only minor changes were required in executing the strategies as described by the hub responsible (15).

One of the interview objects stated that relationships and collaborations between departments are never as good as whenever a crisis strikes (17). This has led to people and functions coming together, developing their trust and inter-organizational relationship. A way of nourishing the trust between the departments was to develop the communication and the involved parties' accountability. This was done by following up and reporting back to each other in the previously mentioned meeting structures.

4.4.2 Summary of the found capabilities

The following table summarizes the found capabilities connected to case C.

Table 4.4: Resilience capabilities in Case C sorted into the capability framework.

Anticipation	Resistance & Response	Recovery
Situational awareness	Flexibility	Contingency planning
• Department BCP	• Built up new supply and demand management processes • Strategic, tactical and operational with decentralized decision making • Dual production sites	• Scenarios were planned with certain action measures.
Increasing visibility	Collaboration	Market position
• New KPIs indicating the direction of COVID's spread.	• Strategic use of excess capacity	• Financial strength that allowed investments
Robustness	Redundancy	Post-knowledge management
• Multi-sourcing • Dual production availability, alternative routing of components and products	• COVID BCP framework • New meeting and information structures	• Looked beyond risks seeing opportunities
Building security	Agility	Building social capital
	• Building up and reviewing current supply setup	• Inter-organizational relations strengthened. Fostered new cross-functional processes • Developed trust for teams' responsibilities
Pre-knowledge management		
• Understanding of supply chain structures.		

5
Analysis & Discussion

In this chapter, the empirical data found will be connected to the literature review aiming to provide an answer to the defined research questions in *Section 1.2*. The research questions are brought up in consecutive order to provide structure and lead up to the answer to the third question answering what improvements could be implemented.

5.1 How has the case company managed previous disruptions?

To answer the first research question, the three cases' impact and consequences are analyzed and discussed within each case that covers involved parties and processes applied. Included in these are factors that would impact the performance of the supply chain as previously visualized in the disruption profile by Tukamuhabwa et al. (2015). All of the cases were then approached in a cross-case analysis to answer the stipulated first research question to draw analyzes of their relations and incoherence.

5.1.1 Case A: Supply disruption - A sub-supplier failure

The supply disruption came to have a impact that implied quick mitigation of potential disruptive consequences. Alfa was a key tier 2 supplier to the five suppliers providing components. It produced a large share of the global market demand, making the disruption complicated to solve (4). One supplier was not able to provide a bridging solution until the sub-supplier had recovered. Further, the full impact analysis from Alfa was not established for a long time, nor when Alfa was expected to recover from the failure. This made it difficult to overcome the disruption. Ericsson was obliged to look outside of current supplier agreements for short-term and long-term solutions. There were several components affecting Ericsson. The impacted components were troubled to different degrees and some problems were more easily solved than others. The disruption led to production stops for certain products, which in turn led to longer lead times for Ericsson, in the short horizon (5).

As a consequence of these implications, several solutions were required to handle the disruption. These solutions are derived from different internal parties' actions. The inbound team located and bought available capacity from the main supplier, as they indicated LTB on all the components they could not supply (2). Further, they

tried to source from their four other already established suppliers to build a buffer. This was done quickly to assure that the available material was directed to Ericsson before other actors realized the effects of the disruption. The quickness of these actions generated more time to handle the disruption and postpone the impact on production further. To establish new sourcing alternatives, the sourcing team contacted suppliers to create new contracts to provide long-term solutions (3). R&D was approached in arrangements for the components that had no available alternative plans from suppliers. Either by switching components directly or redesigning the components (6). Product owners verified the alternatives found to assure that the finished product was not affected by the changes made. Through these mitigations, customers didn't perceive large problems in delivery which was an ultimate goal to achieve. The disruption constituted better connections between the different parties involved. Additionally, it enriched the understanding of tier 2 suppliers' operations influence on tier 1 suppliers. The importance of the sub-supplier, in this case, might not be Ericsson's direct responsibility, it is the supplier's obligation. Nonetheless, monitoring and assurance that this is executed lie on Ericsson to ensure disruption of this kind can be handled properly again.

Processes were operated in the mitigation of the disruption. The risk analysis acted as a groundwork to extract a feasible action plan to ensure components could be delivered to production. The creation of a task force was organized from a determined process, which aided the communication and collaborations between the different functions and teams involved. A new inter-organizational process of weekly meetings was formed afterward, not due to the disruption per se but due to other disruptions. It could however have aided the mitigation of this disruption to communicate the criticality found in components that would affect Ericsson's production in near time.

5.1.2 Case B: Demand disruption - Uncertain demand

The geopolitical situation between Swedish authorities and China had a definite impact on Ericsson in this case; a significant drop in demand. As the deal required extensive investments in unique components, the risk of scrapping unused assets rose significantly requiring a delicate approach to limit the exposure. The monetary losses of the deal have not been disclosed to the authors, due to difficulties in quantifying them as some components are still in stock and deliveries to the project are still expected.

The uncertainties of the demand, as a consequence, led it to be treated as a supply chain breaker. The case was thus treated in a specific section of the S&OP, recurring in each cycle. This can be seen as a proactive measure, where a demand risk was identified, and thus treated differently and monitored as Dittfeld et al. (2021) suggests. Decisions about investments connected to the demand in question were therefore brought up in the business area S&OP. During the disruption's development, certain process developments were done. There were some adaptations to the S&OP where new material and a new stream of data were taken into the supply

chain breaker decision point that had not been done before. In previous situations, capacity-related issues of the whole project were presented and quantified by the Networks SCM team, connected to the demand planners' proposed demand scenarios. The additional data provided by the same team was the quantification of project costs, as well as specific component investments required for different demand scenarios proposed by the market area. This led to a better overview of the financial implications of the decision. This was enabled by an earlier involvement of the PDU, that had not previously been done.

In the end, the business area S&OP took a higher demand decision than the market area S&OP proposed. That eventually led to a position where Ericsson took a higher risk. Nonetheless, that was seen as necessary due to the potential loss of sales if they were not able to deliver. Involved stakeholders are regardless of the outcome satisfied with this part of the approach, and will use it in similar situations in the future.

5.1.3 Case C: Macro disruption - COVID-19

This case had a lot of impact on Ericsson, not only on a local scale but also on a global scale, affecting all parts of their supply chain. The disruption's potential large-scale impact on Ericsson's supply chain performance indicated the need for adaptation and reconfiguration within all parts of the supply chain to handle the disruption efficiently. A decision was taken early on that the disruption would affect the long-term horizon for years ahead and should be handled accordingly. Approaches to control the spreading of the disease with e.g. lock-downs and herd immunity required specific strategies that were tailored to the geographical issues they implied. Uncertainties in demand were analyzed, both through direct canceled orders and the potential demand decline on the global market. It was quickly realized that this was not the case. The impact risks of the disruption were handled concerning three factors: supply risk, production risk, and transportation risk. The supply risk contained risks of inbound components from suppliers based on their region and country of origin. The shutdown of factories or limited capacity was the main focus in terms of the production risk. Regarding transportation risks, problems were connected to the transportation of goods between different regions, for both components and finished goods.

Numerous consequences and potential consequences for Ericsson could be identified. The disruption created a ripple effect leading to the semiconductor crisis and the global shipping crisis with increased lead times of components. Several strategies were deployed to handle the previously mentioned risk factors e.g. increased buffers, dual production strategies, and changes in sourcing strategies. The formation of a business continuity team between R&D, sourcing, and inbound was an additional strategy that helped the mitigation. The effectiveness of the implemented resilience strategies can be interpreted to be one of the factors contributing to the company's seven consecutive quarters of growth, regardless of a pandemic, thus a competitive advantage (14). This goes in line with Tukamuhabwa et al.'s (2015) reasoning that

growth can be the outcome of an effective mitigation strategy. The implemented BCP framework with action plans on how to prevent the impact was seen as a key process. Weekly coordination meetings with a leadership team were organized to provide collaboration and to make decisions. Further processes were structured to align production facilities and material availability as input to the weekly coordination meetings.

5.1.4 Cross-case Analysis

The cases differ widely from each other in terms of impact, consequences, processes, parties involved, and how they have been handled. The ability to anticipate differs between the cases as seen in the disruption classification framework (McKinsey, 2020). According to the framework, Case A had a limited possibility to be anticipated whilst the demand case had quite a long time frame of anticipation. The last case had anticipation within the week-to-month horizon. Although predicting where the outbreak of the pandemic would originate from was difficult, anticipating the spread of the disease and its regional impact was a more manageable task once the origin was determined.

The cases had different supply chain planning scopes. Case A was a supply-side problem affecting components and was handled within the operational planning scope. The source was a disruption at a sub-supplier affecting an isolated component group. Case B on the other hand was a demand disruption being handled in the tactical and strategic domain, with operational implications as a rippling effect. It affected a specific market and customer unit of Ericsson. The last, Case C, was a problem that affected the whole supply chain and through all dimensions, with global geographical impact leading to several cases comparable to the first two cases.

Looking at the processes used throughout the cases, the formation of the task force has been seen as a key attribute since it enables a variety of capabilities. It enabled alignment and information coordination steered the mitigation actions in a unified way when returning to the new or original state. Further, there have been developments in processes, as a reaction to a disruptive event, that has been adopted into the routine work, leading to new meeting structures and communication channels. This shows the agility of adapting to the dynamics of disruption and a degree of process innovativeness. This makes the mitigation of a new disruption more efficient as mitigation processes are in some cases already in place and known. Supply chain breakers and crisis meetings are processes that go in line with Dittfeld et al. (2021) suggestions of proactive and reactive measures in the S&OP process, contributing toward resilient supply chain planning. Albeit, when the measures should be implemented is arguable as it depends on the context of the industry and organizational characteristics (Kristiansen & Jonsson, 2018).

It has been concluded that the cases are different, thus different attributes are important when mitigating them. Looking at the supply case, the ability to react fast, to secure the available suppliers on the market, while at the same time being

structured and clear in what products to prioritize to avoid outages was important. Balancing agility and structure. As supply disruptions of this kind are difficult to anticipate, proactively designed cushions from redundancy and built-in flexibility were critical components coming out of the disruption successfully. The previously updated buffer strategy, due to COVID-19, gave Ericsson more time to mitigate the disruption. Collaboration can also be identified as a significant capability, both internally, with e.g. R&D involvement, but also with suppliers. In the demand disruption case, the attributes are completely different. Here, considering all available information slowly converging to what is seen as the best business decision was important. Entailing situational awareness being an important, considering risks and work to contain all the identified risks in the most effective way possible. That ability is enhanced by good cross-functional collaboration, information sharing, and general risk avoidance and containment through data-driven decisions. The macro disruption involves so many functions that it requires a dedicated strategy including governance and alignment to handle the magnitude of the disruption. Requiring not only agility in solving the short-term issues, but also considering the short-term issues in the long term planning to see the potential long-term effects, enabling proactive measures. Pointing out important capabilities is difficult as different capabilities were important depending on the situation. This indicates that a more holistic approach on the SCRES capabilities are required to be resilient.

5.2 Resilience capabilities applied

The empirical data is dissected into the three corresponding parts of SCRES capabilities as seen in *Section 2.2.4*, to answer the second research question. Following these elements a summarized table of capabilities found throughout the report is displayed with a general discussion of what capabilities are possessed and applied.

5.2.1 Anticipation

Anticipation regards a company's ability to discern future disruptions. This includes many capabilities such as an understanding of vulnerabilities in the supply chain and thereby planning for disruptive situations to become reality for the focal firm. Sensing abilities have been found in all cases with supplier- and customer-related information being fed to the central supply and demand meetings. Risk awareness is worked on through early recognition of the potential weaknesses of the functions. This is done through functions continuously working with continuity planning and gathering knowledge, leading to processes assessing potential supply chain breakers.

The awareness and preparations of potential scenarios of COVID can be seen as a success. It is believed by the authors that the anticipation of eventual outcomes contributed to Ericsson's ability to effectively deal with the crisis. This indicates Ericsson's ability to pick up potential risks and supply chain understanding of how regional issues with COVID could develop into something that had not been experienced to the same extent before. In the demand disruption case, the risks and thus the vulnerabilities of the deal were known for a long time which started an informed

decision-making process. Having this process in place, integrated with the built-up meeting structure, provides a good foundation that can be further developed as the company gathers more experience. The supply disruption occurred with little to no notice, and vulnerabilities of the specific parts of the chain were not recognized completely. Being able to predict and sense this type of disruption is difficult, making the preparedness of resisting and responding to one even more important. The anticipative capabilities in that case are thus more focused on building a robustness, and acknowledging potential supply risks.

The knowledge and experience of previous disruptions have also influenced the ability to proactively prepare and foresee disruptions. It is described that knowledge from previous disruptions is applied when mitigating new ones. This means that some of the knowledge lies within the people involved. To maintain this knowledge it is important to work with ways of sharing it, to not become too dependent on some individuals, but also to become more efficient as a team.

5.2.2 Resistance & Response

Whenever a disruptive event occurs it might strike out parts of the supply chain immediately, making resistance capabilities necessary as responses might not be quick enough. These abilities buy time for adaptations and responses.

Redundancy and flexibility capabilities are proactively built-in cushions that future performance relies on whenever a part of the chain is weakened. They are in broad terms the tools that can be utilized when responding to the disruption in the short term. Redundancy of capacities such as supplier, production, and buffers, combined with the flexibility of multisourcing, dual production, and processes, are examples of capabilities existing at the case company. Current flexibility and redundancy initiatives are sound, and in sync, as they enable each other. The authors can further see that these initiatives put them in a good position to handle geopolitical issues such as trade tariffs, and other local disruptions in the future. The specific initiatives contributing to this are the spread of production sites, with dual sourcing abilities, and the diversified sourcing strategy resulting in a dispersed geographical footprint. However, to facilitate these capabilities in a good way, you need to be agile and coordinated, thus having rough plans for these scenarios. Whether current redundancy and flexibility initiatives and strategies are enough, or too much, cannot be concluded as it requires a further substantial in-depth understanding. However, from an outside perspective based on these cases, they have proven to be sufficient.

An activity to establish collaboration is the creation of a cross-functional task force, which could be seen in all three cases. Establishing a forum where dedicated employees work with solving the issue; analyzing, reporting, participating in meetings continuously, and most importantly aligning the efforts. Cross-functional collaborations could also be identified outside of the task forces, as previously mentioned, e.g. R&D and inbound in COVID. These have played a significant role in Ericsson's mitigation work. Approaching COVID, employees quickly realized the importance

of structuring the information flow, an attempt to make sure that all participants act on the same information. This was also done in the supply disruption, though not with the same success as experienced by management in COVID. As information gaps between the operationally involved and task force were found, leaving e.g. an operationally responsible employee without critical information for three days. The issue of information asymmetry is brought up in all three cases; indicating the need for structuring the information flow during disruptions.

The functions are said to have authority, thus a certain degree of freedom to operate on their own and take brave decisions. To coordinate the different efforts of the functions during COVID, Ericsson saw the need of creating new meeting structures. Weekly meetings were initiated setting the focus of the upcoming period, aligning the efforts, and giving the different parties insights into other functions. These meetings made the organization more agile, where efforts could be steered in the direction required. Although, some meetings were said to have had an unnecessary amount of participants where trust in colleagues and processes could have loosened the schedule of many, liberating time that could be spent on other value-adding activities.

The agile, adaptive capabilities have appeared in different ways; through new processes, adaptations of processes, formations of new collaborations, and the ability to work ad-hoc. During the mitigation of disruptions, new meetings, processes, and programs have been formed to e.g. evaluate material availability and trigger action plans, implement new data to business investment points, etc. Though processes have been formed, it is known that many of the actions were done ad-hoc and based on previous knowledge of the individual. This was seen as one of the enablers of quick reaction in the supply case, being quick to approach other suppliers, and avoiding issues when the great mass realizes the issue. Though the authors see potential issues with such an approach, based on insights from the empirical data. Working ad-hoc can lead to inefficiency, missing important aspects such as information spreading issues, and high dependency on human capital as previously indicated.

5.2.3 Recovery

The recovery capability, thus the ability to bounce back to the (new) normal state of the supply chain and the ability to learn from the disruption. A big part of that is contingency planning. Contingency planning has been an important activity throughout the cases. Foreseeing e.g potential lockdown situations in COVID led to new strategies in sourcing, buffers, and production set-up. This leads to better adaptations of the disruption. Ericsson did not only plan for their mitigation of internal impact but also how competitors might be affected. That meant plans for redirecting resources to certain geographical areas, where advantages could be found. The done contingency planning also led to a situation a focus on executing plans, rather than considering future actions. In the supply case, they used a structured way of tackling the most troubling components. Though, it was identified that the current processes of handling critical components had flaws between R&D and microwave

SCM. No clear and flexible process existed at the time handling these components that initiated the discussion about appropriate measures required. That led to more time being spent on carrying out mitigation activities which indicates the importance of having processes in place.

Another capability helping Ericsson in its ability to recover is its position in the market, and the resources available. No deep financial analysis has been done, though it can be seen that both monetary and human resources have played an important role in the mitigation.The resources have enabled investments to proactively ease the recovery or prevent severe effects on deliveries. Examples of investments that have been brought up throughout the report are the build-up of buffers, production capacity, and continuity planning.

Post-disruption knowledge management is an important part of being resilient. Taking the time to learn from previous experiences and make conscious changes in existing resilience capabilities preparing for future disruptions. This has been seen in several forms in the cases; such as sourcing changing supplier criteria, new processes have been adapted and become a part of the weekly routines, etc. Even though several learnings have been observed, some post-disruptive thoughts might be lost as feedback sessions were not performed in a defined structure.

The disruptions seemed to have built up the social capital within Ericsson. As a result of new cooperative processes and new ways of building trust through accountability, it can be seen that the inter-organizational relationships have been affected positively. This has led to further understanding of the importance of involving different parties at certain stages and disruption types, e.g. R&D involvement.

5.2.4 Resilience Capabilities Reflections

From the cases, a summarization of observed capabilities has been constructed, see *Table 5.1*. By observing the table, it can be identified that all capabilities were applied in some way adding all the disruptions together, except for one, building security. That panel regards a company's ability to build security in the chain against deliberate attacks such as counterfeiting, cyber security, and freight security (Ali et al., 2017). That capability has not been covered as elements of this have not been provided during the interviews but can be relevant in other cases.

Table 5.1: Summarization of capabilities found in the cases.

Capabilities/Source	A	B	C
Anticipation			
Situational awareness	●	●	●
Visibility	●		●
Robustness	●	●	●
Building security			
Pre-knowledge management	●	●	●
Resistance & Response			
Flexibility	●	●	●
Collaboration	●	●	●
Redundancy	●	●	●
Agility	●	●	●
Recovery			
Contingency planning	●	●	●
Market position			●
Post-knowledge management	●		●
Building social capital	●	●	●

As almost all capabilities are possessed and applied, with explicit information found from respondents, it shows that there already exist quite extensive resilience practices.

5.3 Improvements Areas and Future Work

Even though all capabilities were found, as disclosed in the previous section, areas of improvement were identified in four segments. The themes of the improvement areas are the following: sensing and mapping vulnerabilities, information flow and data management, processes, and learning from disruptions. The areas have been chosen based on indications given by interview objects, but also via gaps between the empirical data and the presented SCRES framework (see *Figure 2.5*).

5.3.1 Sensing and Mapping Vulnerabilities

Though the disruptions have had different levels of possibility to be anticipated when they would strike, being able to sense and be aware of potential vulnerabilities is something that will always be of importance in being resilient (Das, 2018). The awareness gives one time to act, and proactively plan for contingent events to avoid, contain or control the supply risks. Currently, Ericsson works with function-wise

and cross-functional continuity planning, where different scenarios are evaluated and planned for. Though we see the opportunity to excel in this work by implementing simulation possibilities, e.g. a digital twin. Through simulation, stress-testing of plans could be done and potential mitigation strategies are compared, leading to more data-driven decisions being made (Ivanov, 2020). An example in supply chain planning would be that the simulation could for example compare different production scenarios, including the probability of contingent events when deciding on what investments to make. This information could then be fed to e.g. the tactical dimensioning meeting. A downside with the implementation of additional analysis tools is the addition of work that needs to be considered and investigated further.

Implementing new capabilities in sensing, and planning for high- and low-probable events will not only amend the sensing capability. The expected outcome of increased sensing capabilities would enable the company to allocate its resources more efficiently; see what flexibility, and redundancy might be insignificant while enabling them to prepare eventual responses making them more responsive. Planning the contingencies enables the focal company to evaluate mitigation strategies and see what type is most effective from a benefit to cost point of view, which might not be possible to the same extent during a disruption as decisions might be rushed.

5.3.2 Information Flows and Data Management

When disruption hits, new information and data are taken in quite rapidly. Efforts to the best abilities are made to establish an understanding of the effect, and the potential effect of the disruption. Throughout the cases and observations, it could be obtained that improvements in data handling and sharing information between parties could have been done more efficiently. Incorrect and old data have been shared internally between parties and functions in the cases, which have also differed from external data input. Receiving information was occasionally recognized as unstructured and not received as quickly as it could have been. Sporadically, unnecessary information was sent that brought confusion instead of clarity. However, this is a balance that should be taken into consideration as it might bring reassurance instead of confusion. There could thus be a benefit of having more developed information governance structures including whom to contact. Trust can be built and developed additionally in the organization to create stronger cross-functional bonds and remove confusion, and unnecessary discussions and emails. One recommendation is to continue the structured information approach used in the COVID-19 case. Where days were set for preparation and publication of data, minimizing the probability of using incorrect data while it removes the step of chasing data. To summarize, a more structured way of handling new sources of data is recommended.

To the author's knowledge, data is taken care of in multiple systems that are not continuously updated to the degree it possibly could. How the multiple systems are connected and data is updated could be investigated, which is known to the authors that it is already in development. There are further several observations of work with manual data, calculations, and updating information between systems using

e.g. Excel. Improving this will enable increased visibility between parties, especially in a disruption where countless new information streams need to be taken care of in a systematic approach. This also enables that correct information to be discussed and decisions could be taken in a faster and more efficient way.

5.3.3 Processes

Processes and process adaptations are important components of efficient mitigation work. Several processes have been adapted and created in the emergence of disruptions. The quickness to adapt and create new processes has been of various outcomes, as some have appeared after the disruption, as in the supplier failure, while others appeared with the disruption, in the demand case. The challenge here is to see how some of these activities can be built into the formal processes. We can thus see the need of developing an end-to-end understanding of the processes, to see how the inputs and outputs can contribute in other ways, and avoid double driving.

During the supplier failure, roles and involvement of functions did not work as efficiently as wanted. Our suggestion to overcome this issue is to standardize the roles and expectations of involved parties. This is by establishing a groundwork, and framework, in how disruptions are mitigated to have a documented base to partly rely on. The groundwork's goal is to avoid eventual confusion and delays in actions. During the cases, much of the collaboration and roles are defined in the task force. The authors do not believe that task forces are something to strive for as a main component in disruption solving. The main observed issues are that they might not be sustainable in terms of raised workload, nor the most efficient approach in solving disruptive events due to the ad-hoc approach. A state to strive for is one where most events can be handled within existing, or modified, processes. Where potential exemption analysis required in some disruptions is set up as probable input feeding the existing process. Having processes in place also mitigates the risk of losing valuable expertise if important players decide to leave the firm, or transfer to other positions. This is not an easy transformation to be done, therefore we suggest an interim step, in the form of setting up a general process standard in the different types of task force teams. This may exist already to a certain degree, but not to the author's knowledge.

5.3.4 Learning from Disruptions

Another area of potential is post-knowledge management, being able to fully leverage the knowledge gathered from previous disruptions. A gap has been identified in our study that post-disruptive feedback might not be used to its full potential. The current retrospective review of disruptions seemed vague, specifically when talking to some of the operatively involved employees. Rice and Caniato (2003) found in their research that one thing that set leaders in resilience apart from others was their ability to learn from the experience gathered from disruptions. That is then used to take action and make changes both in the design, operating the supply chain, and strategy. Tier 2's dependency on tier 1 could be spread to other functions at

Ericsson to reassure learning has been made from the additional knowledge built. Future disruptions could therefore potentially be avoided by second-tier dependencies when multi-sourcing strategies are applied to increase resilience, as an example. Another is the involvement of different roles and functions during the disruption. Synergies with previously mentioned potential in having processes are identified, as these improvements can be seen as easier to be implemented if the processes are mapped.

Learning from previous disruptions also equips supply chain managers with the necessary skills to identify when and what actions are appropriate. Blackhurst et al. (2011) conclude that managers with experience and training are more probable taking the most effective actions in case of a disruption. We, therefore, recommend the implementation of feedback gathering and discussions; assessing what was done good and could have been done better through constructive proposals. First on function level and then cross-functionally to know what they could have done to help each other to capture structural issues, but also operational.

6
Conclusion

The thesis aimed to evaluate Ericsson's SCRES, by looking at the mitigation of three different cases in different domains of the supply chain. The first step was to investigate what activities, processes, and strategies were applied to mitigate the impacts. The cases' differences have been concluded to lead to different attributes being more, or less important. That could be reflected in the different focus areas; the supply disruption case required agile and quick responses, the demand case required skills in composing data to make informed decisions, and the macro case governance and alignment.

Ericsson possessed and applied many of the capabilities that the literature proposed and no significant gap was identified. Common important capabilities in the cases were the built-up redundancy and flexibility, a cross-functional collaboration that was accelerated by the formation of task forces, process structure, and adaptations to the dynamics of the disruption. Though areas for improving existing activities were found. To further excel in their resilience work, sensing abilities, information structures, processes, and learning abilities can be developed.

This study provided an overview of how a company can handle different types of disruptions and provided a good platform for identifying overlapping capabilities that have led to successful mitigations, but also areas of the mitigation work that can be excelled to be even more prepared for future disruptive events. The methodology can thus be applied to other companies in other regions and markets, and for other types of disruptions.

6.1 Academic Implications and Further Research

The focus of this thesis was on gathering information on what SCRES capabilities are utilized throughout three different types of disruptions. Comparing the three cases gained insights into how the mitigation of these differed, and what identified capabilities were applied in each disruption.

The thesis could serve value to both academia and to industry professionals who want to explore the subject of SCRES connected to case studies at a global firm with a focus on the supply chain planning perspective. The study have also laid a foundation in presenting how some activities and strategies performed contribute a company's SCRES.

As the thesis strived attain an overview of Ericsson's capabilities when mitigating disruptions we have thus not found specific parts that could have been done better. The fundamental limitation was the lacking of reference points, other disruptions, where the activities could have been compared. There are also difficulties in applying the findings and compare that to capabilities applied and discussed in academia; this is due to contextual factors playing in, making it difficult to copy a concept and apply it to the case company's, or a new environment.

Based on the thesis limitations, the authors can find further research areas of interest. The first example would be performing similar studies with a narrow focus area. Example areas of focus could be on a disruption level, where each type of disruption could be assessed in several disruptions within the same disruption category. Another focus area could be how resilience could be improved within a specific function, leading to more tangible conclusions. Another finding in the thesis was the use of processes within the planning domain. The authors can see the benefit of further researching the possibilities of integrating resilience processes into current ways of working.

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A

Appendix

A.1 Interview guides

The questions in the template served as a guidance when conducting the semi-interviews for the disruption cases and the process observations. The templates were modified from Zainal Abidin, N.A., (2018).

A.1.1 Disruption case interview template

Introduction to the master thesis:
Introduction about our project and project goals.
Explanation of impact and consequences.
Mapping Ericsson's Supply Chain resilience capabilities
Getting to know the involvement and contributions from each part; how are the disruptions anticipated, responded to/resisted, and finally recovered from.

Introduction of the interview object:

1. What impacts and consequences have the supply chain disruptions had?
2. Could you please describe your role at Ericsson in short?
3. For how long have you had your current role?
4. What is your team's role?

Description:

1. What parts of the disruption were you involved in? *(Based on the interviewees' responses upcoming questions were adjusted.)*
   (a) Anticipation (YES/NO)
   (b) Response (YES/NO)
   (c) Recovery (YES/NO)
2. What was your role in the mitigation of the disruption?
3. What was your team's role?
4. What were the disruptions impacting your responsibility area?

Communication and collaboration:

1. Communication with other departments?
2. What collaborations existed and evolved?
3. How were the information and data sharing between departments?

Process involvement:

1. What processes do you provide information to or participate in?
   Specifically within the demand domain, and supply domain e.g. GPP, S&OP,

DP, MAF
2. Were there any additional processes during the disruption?

Anticipation questions:

1. What are the methods that you use to prepare for potential disruptions?
2. What types of security do you employ to protect against threats? (natural disasters, disruptive events, deliberate threats)
3. How do you anticipate disruptions?
4. How do you determine the possible treatment and response plan for potential disruptions?
5. Did you have any warning?
6. Does this type of event happen often?

Response/resistance questions:

1. When was the disruption first identified?
2. How was the disruption first identified?
3. Who was the first to identify the problem? Who else was affected? Were you/your company/supplier prepared?
4. What was the immediate impact of the disruption?
5. When, if at all, did your customers notice any negative impacts? How?
6. What was the initial response to the disruption? What were your initial thoughts and actions?
7. Was this completely successful?
   (a) Yes – Were there any other responses taken later?
   (b) No – What other responses were necessary?
8. Did any of your actions make the problem worse?
9. Was your primary concern the length of time that the disruption would last or the severity of the disruption?

Recovery/Learnings from disruptions/Final remarks:

1. Learnings from the disruption?
   (a) Were there some specific moves that mitigated the situation well? Winners?
   (b) Were there some mistakes made; that you have learned from when re-evaluating the situation?
   (c) Following a disruption, do you discuss the event and create an after-action report?
2. Were there any consequences or changes moving forward?
3. General improvement ideas - Things not working as they should or ideally in general?
4. Do you know anyone else involved that we should interview?

A.1.2 Process observation template

Introduction to the master thesis:
Introduction about our project and project goals.
Explanation of impact and consequences.
Mapping Ericsson's Supply Chain resilience capabilities
Getting to know the involvement and contributions from each part; how are the disruptions anticipated, responded to/resisted, and finally recovered from.

Introduction of the interview object:

1. What impacts and consequences have the supply chain disruptions had?
2. Could you please describe your role at Ericsson in short?
3. For how long have you had your current role?
4. What is your team's role?

Process overview:

1. Who is responsible for the different areas; demand and supply planning?
2. Planning team's processes? Who has responsibility for what?
3. What are your team's current challenges or goals moving forward?

Processes and resilience:

1. Do you know of any clear and defined mitigation approach/process when handling disruptions?
   (a) Why/Why not?
2. Are you working with processes in Ericsson's ability to anticipate risks?
   (a) If so, could you please describe them and which teams are involved?
3. Are you working with processes in resisting or responding to disruptive events?
   (a) If so, could you please describe them and which teams are involved? E.g. Information flow, Dividing work, Who to involve, etc.
4. Are you familiar with processes in recovering from a disruptive event?
   (a) If so, could you please describe them and which teams are involved?
5. Are you familiar with processes in reviewing and learning from a disruptive event?
   (a) If so, could you please describe them and which teams are involved?
6. What is your general thought about having processes for everything, is it suitable to have a specific process for mitigating a disruptive event?
   (a) Why/Why not?

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