THESIS FOR THE DEGREE OF LICENTIATE OF ENGINEERING

Creating Resilience and Integration with Cross-Functional Supply Chain Planning

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ABSTRACT

Incidents of supply chain disruptions have been a worrying occurrence for organizations. Resilience is required in organizations to recover from these disruptions. There are various resilience models that have been developed that highlight the capabilities required to achieve resilience. The four main capabilities highlighted in the literature are agility, flexibility, redundancy, and collaboration. Among these, collaboration or integration is an important capability required within the organization and across the supply chain. Integration can be developed around a process, and cross-functional supply chain planning (SCP) is a group of such processes that can develop integration. The purpose of this thesis is to understand how integration and resilience are created in organizations through cross-functional SCP.

To approach this purpose, the thesis relies on literature on supply chain resilience, SCP, and process integration in relation to SCP. A multiple case study was carried out to study integration and resilience. The sales and operations planning (S&OP) process was studied to understand integration within organizations. To study resilience, the various SCP processes used by organizations during the COVID-19 pandemic and semi-conductor disruptions were studied. The thesis builds on multiple sources of data, including semi-structured interviews, documents, and workshops together with case companies.

The findings indicate that integration can take various forms, depending on the context of the organization. Coordination is important across all cases to exchange information between the various functions. Improving collaboration and alignment results in higher levels of integration. But the level of integration required depends on the context. However, response to disruption is dependent on integration within the organization and across the supply chain. The organization changes its SCP processes to adapt to the context. Here, the sales and operations execution (S&OE) process is used to mitigate disruption, while S&OP is used as guidance for S&OE. Ad-hoc processes and teams are also created during a disruption. Top management plays an important role in reorganizing the SCP. People based capabilities like collaboration, knowledge management, decision making are also required. The processes were coordinated through intra-process formalization, informal communication, top management involvement, and strategic alignment. The processes interact with each other to generate flexibility and agility while relying on organization knowledge, assets, and coordination with customers and suppliers. After the disruption, many processes were retained for information sharing. Based on the findings, a model of SCP integration and resilience is proposed.

This thesis is one of the few studies examining the role of demand and supply planning conducted in supply chain planning processes in improving resilience in organizations. By proposing the necessary resources for creating resilience, a model for a combination of resources is created.

This study focuses on large manufacturing organizations within Sweden. Organizations in other countries with different business models, cultures, and supply chains could experience different outcomes from disruptions and require different resources to manage the disruption. More case studies are needed to reveal how resilience and integration can contribute to resilience in various ways.

Keywords: Sales and Operations Planning, Disruptions, Resilience, Sales and Operations Execution, Integration, Collaboration, COVID-19, Semi-conductor

List of Appended Papers

Paper I Ahmed, S., Jonsson, P., & Lind, F. Cross Functional Planning for Sales and Operations Planning (S&OP) Process Integration: A Multiple Case Study.

An earlier version of this paper was presented at NOFOMA 2023.

Author Contribution: The study was conceived and planned by Ahmed. The data collection was carried out by all three authors. The interviews were transcribed, and a preliminary analysis was conducted by Ahmed. All three authors discussed and finalized the analysis. The writing was jointly achieved by all three authors.

Paper II Ahmed, S. & Jonsson, P. Resilience through Routine and Reactive Supply Chain Planning Processes.

An earlier version of this paper was presented at EUROMA 2022.

Author Contribution: The study was conceived and planned by Ahmed. Both authors were involved in the interview process. The interviews were transcribed, and a preliminary analysis was conducted by Ahmed. The findings were jointly finalized by both authors. Jonsson wrote the discussion section, while Ahmed wrote the rest of the paper.

Paper III Ahmed, S. & Jonsson, P. Transition of Supply Chain Planning Processes during Disruptions.

This paper will be presented at EUROMA 2024.

Author Contribution: The study was conceived and planned by Ahmed. Both authors were involved in the interview process. The interviews were transcribed, and a preliminary analysis was conducted by Ahmed. The findings were jointly finalized by both authors. Jonsson wrote the discussion section, while Ahmed wrote the rest of the paper.

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Sahil Ahmed

Contents

Chapter 1

Introduction

1.1 Background

With disruptions such as the COVID-19 pandemic, the topic of resilience has gained a lot of attention from academics as well as organizations (Castillo, 2023). The disruption has resulted in stockouts, late delivery of products, transportation blockages, shutdowns of factories, and a lack of materials, to name a few. These have gravely affected various organizations and supply chains, rendering them unable to supply their customers effectively. To overcome disruptions and maintain their operations, resilience is seen as a required capability in an organization and supply chain (Christopher & Peck, 2004). As a result, many businesses are now looking to build their resilience through better risk management strategies, diversifying their supply chains, and investing in technologies that can help them adapt to unexpected disruptions more effectively (Münch & Hartmann, 2022). The ability of organizations to bounce back from such disruptions will now be a key factor in their success and competitiveness in the market. It is clear that building resilience is no longer just a buzzword but a necessity for survival in today's uncertain and volatile business environment.

It is possible to think of resilience as consisting of a variety of other capabilities that enable an organization to prepare for, react to, and recover from disruptions. A number of different capabilities have been identified by a variety of authors based on theory and literature reviews (e.g. Ali et al., 2017; Han et al., 2020; Tukamuhabwa et al., 2015). These capabilities have been paired with the different phases of disruption, including readiness, reaction, and recovery. Necessary capabilities include situation awareness, visibility, security, and redundancy in the readiness phase, which occurs before a disruption occurs (Han et al., 2020). The phase that follows a disruption is known as the response phase, and it is characterized by the requirements of capabilities such as agility, adaptability, collaboration, and leadership (Han et al., 2020). During the recovery phase, which is the phase in which the organization recovers to its regular state, it is vital to have capabilities such as knowledge management, contingency planning, and market position management (Han et al., 2020). In light of the development of various definitions and constructs of resilience, collaboration has emerged as an important capability that is required in different phases of a disruption, as well as for supporting other capabilities, such as flexibility, visibility, and agility (Scholten & Schilder, 2015; Shekarian & Mellat Parast, 2021).

Christopher and Peck (2004) was one of the first to present the concept of resilience; since then, collaboration has been an integral aspect of developing resilience.

The emphasis here has been on collaboration and working together at the supply chain level. Greater utilization of resources, financial gains, and improvements in service could result from collaboration among partners during interruptions (Duong & Chong, 2020). The increased visibility and flexibility that result from collaboration are also factors that lead to resilience (Scholten & Schilder, 2015). Despite its benefits, collaboration in a supply chain is difficult to achieve due to the differing objectives of various firms in the supply chain. Similarly, collaboration within a firm across different functions is difficult to realize. In large firms, positions are typically broken down into distinct functions, and these tasks are typically dispersed across the globe in a variety of locations. Therefore, a disruption could have an impact on several aspects of the organization. Overcoming such a disruption would require the combined effort of various functions. In a nutshell, it is necessary for the functions to work together harmoniously. Cross-functional planning is a technique that enables collaboration between the many functions of an organization.

One relatively less explored area of resilience is the supply chain planning (SCP) processes in organizations. After all, everything begins with the planning process, and it seems natural that the first step towards facing a disruption is to create a plan to overcome that disruption. However, there is a lack of studies identifying SCP as an important component of resilience. Dittfeld et al. (2021) considered resilience in the sales and operations planning (S&OP) process. On the proactive side, it is about designing the process for known risks in the supply chain. On the reactive side, the process frequency can be increased to carry out more S&OP cycles. However, S&OP is not created with risk management in focus. Further, Dittfeld et al. (2021) failed to provide details regarding designing the process or how resilience is generated in the process. Resilience for a large disruption such as COVID-19 and a semi-conductor shortage requires more than simply having a process such as S&OP. There are capabilities and other processes that also contribute to building resilience in the organization.

1.2 Purpose

The purpose of this thesis is to understand how integration and resilience are created in organizations through cross-functional SCP. To build resilience in the face of large disruptions, organizations must not only focus on increasing the frequency of S&OP cycles (Dittfeld et al., 2021) but also consider how resilience capabilities can be integrated into the process. It is also important to look beyond just the S&OP process itself and consider other capabilities and processes that can contribute to overall resilience. By studying resilience creation through cross-functional SCP, organizations can better prepare for and adapt to unforeseen challenges, such as the COVID-19 pandemic and semi-conductor shortages.

1.3 Outline of Thesis

In Chapter 2, the theoretical background is provided along with the research questions. The study methodology is provided in Chapter 3, while a short summary of the three papers that constitute the thesis is presented in Chapter 4. A discussion of the findings is undertaken in Chapter 5. Chapter 6 presents the discussion and Chapter 7 presents the conclusions of the work and suggestions for future research directions.

Chapter 2

Literature Background

2.1 Supply Chain Planning Process

The demand and supply planning process in an organization can be mainly divided into three time horizons – short, medium, and long term. The short term SCP usually covers 0 to 3 months, medium term from 3 to 24 months, and long term covers around 2 to 5 years in the future. The three processes are depicted in Figure 2.1. The time horizons vary between different organization and depends on the context. S&OP and S&OE are two common processes for the medium and short term SCP respectively. This study focuses on the S&OP and S&OE processes. They are described in the subsequent sections.

2.1.1 Sales and Operations Planning

S&OP is a planning process that aims to balance demand and supply in the medium term (Grimson & Pyke, 2007). This is a cross-functional planning process that aims to bring together different parts of the organization to create a single plan for the organization. S&OP is composed of various steps in which demand and supply plans are created and finalized. Various functions in the organization, such as sales, marketing, operations, inventory management, and procurement, participate in the process (Grimson & Pyke, 2007). This promotes horizontal integration within the organization. Horizontal integration can also extend beyond the organizations towards the suppliers and customers (Noroozi & Wikner, 2017). In the final step of the process, senior

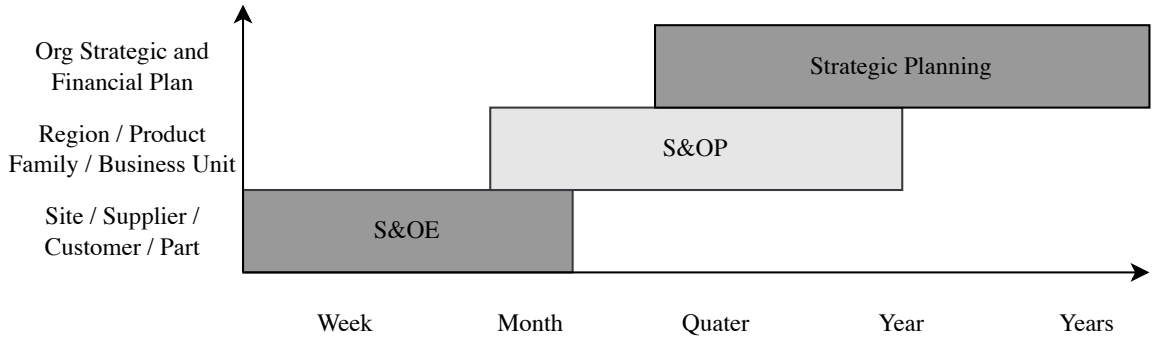

Figure 2.1: Various SCP in organizations. Adapted from Hainey (2022)

management reviews the plans and approves them. The extent of senior management involvement depends on the maturity level of the organization (Grimson & Pyke, 2007). In this way, the plan is modified in line with the long-term plans of the organization. The approved S&OP plan also drives short-term planning in the organization. By connecting both long- and short-term planning in the organization, as well as different hierarchies from senior management to the shop floor level, S&OP promotes vertical integration in the organization.

As S&OP aims to improve integration, this field has received some attention. Tuomikangas and Kaipia (2014) created an integration framework for the S&OP process. Six integration mechanisms were identified: process, organization, tools and data, performance management, strategic alignment, and culture and leadership (Tuomikangas & Kaipia, 2014). Mechanisms are the tools and practices used to promote integration. These six mechanisms were tested against SCP, and the results showed that strategic alignment had the largest contribution towards supply chain performance, while process, organization, culture, and performance management had a low impact (Goh & Eldridge, 2019). In fact, the process was found to have an inverse relationship, and the authors suggested that a rigid process can lead to lower performance because the organization could not deviate from the norm. Organizational bricolage where the organization is able to be flexible is suggested as a driver for S&OP performance instead of process (Goh & Eldridge, 2019). A further study revealed that the organization culture provided had an indirect impact on supply chain performance mainly through strategic alignment and information sharing (Goh & Eldridge, 2022). Although these mechanisms are important, the extent of integration is not clearly understood. As S&OP includes many steps, the integration requirements in those steps cannot be generalized for the whole process. To understand how integration can be improved, it is essential to understand the requirements in each sub-process.

2.1.2 Sales and Operations Execution

Sales and Operations Execution (S&OE) is similar to the S&OP process but concerns the short term. This is a newer concept than S&OP; hence, the number of studies on it is relatively low. S&OE is one way of solving short-term issues while ensuring that the S&OP plan is followed. This also frees the S&OP from short-term issues that prevent it from achieving its intended purpose (Hainey, 2022). S&OE leads to higher service levels, lower inventory levels, and better demand forecasts (Rodrigues et al., 2023).

Although S&OE is a new concept, other similar processes with different names have existed in organizations, such as quick response planning (Lapide, 2022) and demand control (Bower, 2018). An S&OE is a form of legitimizing and regularizing such activities within an organization, with the objective of handling deviations from the S&OP process. The S&OE process is carried out weekly with a planning horizon of 3 months. Earlier literature has suggested having a weekly and short-term S&OP to address uncertainties (Dittfeld et al., 2021) and new product introductions (Bagni et al., 2022). The S&OE is dependent on the S&OP process, as it keeps track of the S&OP process. It is more detail oriented to the product level, where S&OP is mainly at the product family level. It also follows a similar structure as S&OP by analysing the demand and supply situation and then reconciling them to create a single plan for the organization. There is also feedback from the S&OE process to the S&OP process to ensure that the plans reflect the latest operational scenario.

2.2 Integration in Organizations

Integration is an important concept within supply chain management, as it is required for the smooth functioning of the supply chain, yet it is difficult to achieve. There are two types of integration—integration between organizations and integration within an organization. Internal and external integration is required to improve performance (Stank et al., 2001). Integration is defined as "a process of interaction and collaboration in which manufacturing, purchasing, and logistics work together in a cooperative manner to arrive at mutually acceptable outcomes for their organization" (Pagell, 2004). However, this definition only contains three functions—manufacturing, purchasing, and logistics—but the integration of other functions within the organization, such as sales, marketing, finance, and product development, is also important.

There are many terms associated with integration, such as coordination, collaboration, cooperation, and alignment. These terms are used interchangeably in research. To develop a unified model, integration has been defined as a combination of collaboration, coordination, and communication (Pellathy et al., 2019). Here, collaboration is defined as how different functions establish goals and work together, coordination as jointly managing the flow of operational activities, and communication as the flow of information for collective decision making and action (Pellathy et al., 2019). Within S&OP, there is no clarity regarding the definition of terms. Tuomikangas and Kaipia (2014) developed the concept of coordination in S&OP, which consists of six factors: organization, process, tools and data, performance management, culture and leadership, and strategic alignment. The factors for integration as per Oliva and Watson (2011) are information quality, procedural quality, and alignment quality. Alignment quality is achieved when organization and functional goals are synchronized and is considered more important than procedural and process quality in achieving integration (Oliva & Watson, 2011).

2.3 Supply Chain Resilience

Christopher and Peck (2004) introduced the idea of resilience into the supply chain. Various definitions of resilience have been proposed over time. Resilience in this study is defined as "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). There have been attempts to unify the definitions through literature reviews (Hohenstein et al., 2015; Ponomarov & Holcomb, 2009; Tukamuhabwa et al., 2015), but so far, there has been no consensus. The spread of definitions and concepts that vary differently has made it difficult to create a theory of supply chain resilience (Castillo, 2023). Resilience has also been divided into different stages. The stage before the disruption is called readiness; just after the disruption is response, getting back to the previous stage is recovery, and after recovery comes a growth stage (Hohenstein et al., 2015).

The term supply chain could be replaced with organization as in "organization resilience" instead of "supply chain resilience". However, many authors choose to call it supply chain resilience, despite only studying a particular organization (for e.g. Müller et al., 2022; Münch & Hartmann, 2022; Shen & Sun, 2021). By contrast, there are few studies that define it as organization resilience (e.g. Ambulkar et al.,

2015; Conz & Magnani, 2020; Dittfeld et al., 2022; Essuman et al., 2020). However, the difference between organization and supply chain resilience concepts is very thin. Studying resilience has been done through case studies, surveys, and mathematical modelling. Many recent case studies have been related to the COVID-19 pandemic disruption for online retailers (Shen & Sun, 2021), automobiles, and pharmaceuticals (Münch & Hartmann, 2022), various manufacturing industries (Müller et al., 2022), non-profit (Kober & Thambar, 2022), logistic service provider (Hohenstein, 2022).

Integration is considered an important capability that can improve resilience. Different studies have pointed towards the importance of integration at the supply chain level (Juan et al., 2021) but not so many at the organization level. Integration practices include information sharing, joint forecasting or planning, and resource sharing (Dittfeld et al., 2022; Qi et al., 2022). Integration practices have been shown to reduce the time to recovery (TTR) during the COVID-19 pandemic (Qi et al., 2022). Similarly, quick decision making with suppliers, providing support, and coordinating the production process is how integration with suppliers is carried out (Münch & Hartmann, 2022). An integrated supply chain where the control of different entities is with the main organization can also improve resilience (Shen & Sun, 2021). Most integration practices are about information sharing, which makes them equivalent to visibility. Effective integration also requires that these mechanisms be in place before disruption (Shen & Sun, 2021). However, firms can engage within and beyond the supply chain, such as governments, to improve their resilience (Shen & Sun, 2021). Integration is so important that other capabilities such as flexibility, agility, and visibility depend on integration (Juan et al., 2021; Scholten & Schilder, 2015; Shen & Sun, 2021).

Flexibility is another capability that can improve resilience. Flexibility has been cited as the most important capability for resilience (Shekarian & Mellat Parast, 2021). There are different types of flexibility. Product flexibility, in which products can be changed due to the situation, might be difficult to achieve during a disruption, such as the COVID-19 pandemic. Product flexibility can be achieved only if suppliers are able to supply the necessary components. Product flexibility, along with integration, is required to improve resilience (Qi et al., 2022). Therefore, such resilience requires the support of the supply chain. Operational flexibility, in which processes are changed, is also important for resilience. Existing processes were modified to account for pandemic-related factors to improve forecasting and distribution planning during the COVID-19 pandemic (Shen & Sun, 2021).

Agility is the ability to change quickly as per the situation (Dubey et al., 2018). Internal to the organization, it translates to making quick decisions, whereas externally, it is about focusing on customer needs and increasing communication with customers (Münch & Hartmann, 2022). Flexibility is also shown as part of agility, along with visibility and velocity (Jüttner & Maklan, 2011). Visibility leads to velocity, which, in turn, leads to flexibility (Juan et al., 2021). However, here, flexibility is the ability to change, and agility is how quickly that change happens. Therefore, this definition is similar to the definition of velocity provided by Jüttner and Maklan (2011).

Redundancy includes dimensions such as back-ups, excess inventory, and reserve capacity (Chowdhury & Quaddus, 2016). Redundancy is mostly related to the pre-disruption phase of a disruption, as it is not possible to build redundancy after a disruption has occurred. It helps to reduce or even mitigate the impact of a disruption, especially supply disruptions (Shekarian & Mellat Parast, 2021). However, it is not always possible to be resilient through redundancy, as it is difficult to know which area

to invest in for redundancy.

Technology and Artificial Intelligence (AI) are other ways to improve resilience. Digitalization has helped improve resilience through the automation and analysis of data (Shen & Sun, 2021). However, digitalization is not considered in this thesis and could be an avenue for future research. The use of technology for data analytics depends on the fact that data should be available in the first place. This usually comes from collaboration with suppliers and customers. Other technologies that help with resilience come from AI (Modgil et al., 2021) and digital twins (Ivanov & Dolgui, 2021), although both can be considered advanced ways of analyzing data.

Another area of study is the effect of context on supply chain resilience. Not all capabilities are equally important or required in all contexts. Resilience depends on the context in which it is required. A Made-To-Order (MTO) requires more collaboration, while a Made-To-Stock (MTS) could focus on redundancy (Dittfeld et al., 2022). This is because MTO requires working closely with suppliers while ensuring that the required component is available, whereas MTS has fewer raw materials, which can ensure that they can stock more of it. MTS also have stable demand, which enables them to stock larger inventory of material.

2.4 Problem Discussion and Research Questions

Integration is established as an important capability for resilience as well as for supply chain and organization performance. As integration is developed around a boundary spanning activity (Pimenta et al., 2016), one way of achieving integration across the organization is through cross-functional SCP processes. Studying an S&OP process can provide insights into how integration is developed, as S&OP was developed with a focus on improving integration across the organization and involving various functions (Grimson & Pyke, 2007). S&OP integration mechanisms was developed through a literature reviews by Tuomikangas and Kaipia (2014), and a survey validation of this research pointed out the varying importance of various mechanisms for performance (Goh & Eldridge, 2019). Further research is needed to explore the effectiveness of different integration mechanisms in various organizational contexts. Additionally, case studies of the successful implementation of cross-functional supply chain planning processes could provide valuable insights for organizations looking to improve integration. By understanding the importance of different mechanisms in achieving integration, organizations can improve their overall performance. Therefore, the first research question (RQ) of this thesis is:

RQ 1: How does cross-functional supply chain planning lead to Integration?

The disruption due to the COVID-19 pandemic has forced changes in organizations to mitigate the crisis. Although preparing for disruption is one component of being resilient, it is also necessary to respond (Tukamuhabwa et al., 2015). Many of the preparation strategies can be related to increasing visibility, selecting appropriate suppliers, designing flexible products, or increasing inventory, while responses to disruptions would be in the form of developing agility, flexibility, collaboration, and redundancy (Tukamuhabwa et al., 2015). To generate these capabilities, changes in the organizations related to the SCP process are required, as existing processes are created with a specific context in mind that does not take disruption into consideration. The

SCP process must adapt accordingly to the new context. The changes need to fit the process, people, and IT dimensions in order to be successful (Kreuter et al., 2021). Therefore, the second research question is formulated as follows:

RQ 2: How can cross-functional supply chain planning processes change to adapt to disruptions?

The role of internal processes in an organization in generating resilience has not been studied, as current studies focus on the capabilities at a high level without specifying where those capabilities are generated. Among the many processes and policies that an organization implements during a disruption, the SCP process is important. Planning SCP processes provide certain resilience capabilities to the organization (Ur Rehman et al., 2022). The first step towards a disruption is using the planning process to replan in order to minimize the impact of the disruption. By recognizing the importance of planning SCP processes in building resilience, organizations can better prepare for disruptions and ensure their continued success. Therefore, further research into the role of planning in generating resilience capabilities is crucial for enhancing organizational resilience in the face of uncertainty. This motivates the following question:

RQ3: How does cross-functional supply chain planning contribute to resilience?

Chapter 3

Research Methodology

3.1 Case Study Design

The method should depend on the problem. The topics of resilience and integration are complex to study. Using qualitative methods allows the researcher to study this phenomenon up close and in its natural setting as it happens (Flyvbjerg, 2006; Voss et al., 2002). Case research is apt for theory building and answering "how" questions whereas mathematical modelling, and surveys are more suitable for theory testing and modification (Meredith, 1998). Also, there has been calls to carry out more case-based research in resilience (Shekarian & Mellat Parast, 2021), integration (Pellathy et al., 2019), as well as in S&OP (Kristensen & Jonsson, 2018). Case research can provide the depth necessary to understand these phenomena. So, a case-study based research was deemed appropriate. But there are certain challenges associated with this, one of which is setting up boundaries of study. It is difficult to study only a single firm when the influences come from the external environment. This is especially true in the case of COVID-19 pandemic, in which there were multiple and everlasting effects on the supply chain.

Case Selection is an important part of case research. The recommended strategy is to choose cases that are extreme or opposites to each other (Eisenhardt, 1989). However, such cases are required to disprove existing hypothesis. Since this research is more of an exploration of resilience generation in organizations, specific case selection criteria and "convenience sampling" was used. To qualify as a case company, it had to have established S&OP and S&OE processes and it had be a global manufacturing company. We also needed good access to collect data from several different perspectives at the companies. Therefore, cases with available access were selected to study this phenomenon. Convenience sampling was used in instead of theoretical sampling (Voss et al., 2002). This works here because, for one reason, resilience is not a well-developed field with many theories and findings emerging only recently. Another reason is that it is hard to measure resilience and select the best companies. Every organization that experienced the disruption, overcame it through various means with various outcomes. Comparing performance is also difficult due to the differences in context between organizations. The "best company" would also not divulge its secrets that made it the best to prevent competitors from catching up. Studying the "worst company" is also difficult as the company might have ceased to exist. However, there is a lot of value in studying organizations that did manage to be resilient during a disruption. Therefore, cases were selected by approaching various organizations where there was already

contact. This made it easy to get access to the processes and information required to carry out this study.

However, the cases had characteristics that would make them unique. The way the study was carried out could determine how the cases could contribute to existing theory, in addition to the selection of cases (Flyvbjerg, 2006). The cases demonstrate that they design their processes in different ways that are compatible with their environment. The cases are affected in different ways by the same disruption due to the structure of their organization and supply chain. These unique contexts and effects provide different insights into the phenomenon.

The cases chosen for this thesis had different characteristics that set them apart. A common feature is that they were all global manufacturing companies B2B businesses and were affected by the COVID-19 pandemic and the semi-conductor crisis. In Paper I, the criterion was that all had mature S&OP processes, not in the sense of the maturity level from Danese et al. (2018), but that these processes are stable and have been running in the organization for some time. Therefore, these cases were suitable for studying process integration. The cases were different in the sense that they were involved in different industries. This allows for representativeness of the cases, as they represent few of different types of industries.

There also cannot be too many cases as that would prevent from going deep into the respective cases. A balance between number of cases and depth was maintained. Five different organizations were part of this study. In Paper I, the cases are labelled as pharmaceutical (P), confectionary (C), telecommunication (T), medical equipment (M), and automobile (A). In Paper II, the cases are labelled as Alpha, Beta, and Gamma which are the same Organization T, A, and M from Paper I. The case used in Paper III is Beta. The three organizations – Alpha, Beta, Gamma, used in Paper I, Paper II, and Paper III are part of the research project "Building resilience: Aligning supply chain reconfiguration and dynamic planning (REAL)". Details about the case companies are given in Table 3.1.

3.2 Data Collection and Analysis

Case research can involve multiple avenues of data collection, such as interviews, analysis of documents, observations, and questionnaires (Meredith, 1998; Voss et al., 2002. In this research, interviews were the main source of data and were complemented with the use of organizational documents. All three papers utilized the same methods of data collection. The data were also collected over three years, with an overlap between the various papers. Most of the interviews were conducted online, with a few in-person interviews. All interviews were recorded and transcribed. The online interviews were better for recording because of the higher-quality audio recordings obtained. The interviews were conducted in the same way with a set of prepared interview guide. The interview guide was sent to the respondents, along with a description of the study. This allowed them to be prepared. However, during the interview, additional questions were asked depending on the responses, either to seek clarification or to develop a deeper understanding of the topic. The interviews were thus in the format of "semi-structured" interviews. The interview guides used for each paper are attached to the respective papers. The collected documents were used as an aid to triangulate the information from the respondents. This was mainly process description of the various processes in the organizations as well as notes from the meetings.

Table 3.1: Overview of Cases and data collected in this research

Case	Industry	Interview Topic	Paper	No of Respondents from the Organization
P	Pharmaceutical	S&OP Process	Paper I	1
C	Confectionery	S&OP Process	Paper I	1
T or Alpha	Telecom	S&OP Process, S&OE Process, COVID-19, Semi-Conductor,	Paper I, Paper II	8
M or Gamma	Medical Equipment	S&OP Process, COVID-19, Semi-Conductor,	Paper I, Paper II	5
A or Beta	Automobile	S&OP Process, COVID-19, Semi-Conductor, After disruption	Paper I, Paper II, Paper III	10

Apart from the interviews, workshops were held every six months as part of the REAL project. Representatives from the organizations attended the workshops. The data collected, findings, and analysis were discussed with the workshop attendees on numerous occasions. The workshops provided an opportunity for further clarification and validation of the data collected through interviews and questionnaires. The discussions allowed for a better understanding of the processes within the organizations and helped to identify any gaps in the information gathered. Participants in the project were also able to learn from each other's organizations through their participation in the workshop. Overall, the combination of interviews, documents, and workshops proved to be a valuable method for gathering and analyzing data for the research projects.

Carrying out observations would have been a good method for assessing how the organization reacts during a disruption. Observations might not be possible for long-term disruptions, such as COVID-19 and the semi-conductor shortage, but observations of integration in S&OP could have been carried out. However, during the data collection related to S&OP and integration, there were restrictions due to COVID-19. Observations are certainly a method that could be employed in future studies.

The next step was transcribing the data, which was carried out through computerized transcription services before manually correcting the output. The transcribed data were analyzed by coding them into various categories, such as S&OP, S&OE, reactive S&OE, collaboration, integration, and sub-process. Each case was then analyzed first, and patterns were identified. Important quotes related to the organization were also captured. These are presented in tabular format. This fostered a within and across the case analysis. The findings were then discussed among the authors to finalize them, with a few rounds of discussion to develop the concepts in each paper.

Paper I was first presented at NOFOMA 2021 with two cases. Then three more cases were added to it, and a more refined version was presented again at NOFOMA 2023. This paper underwent a few rounds of revision before the current version included in this thesis, The peer reviews as part of submission and comments from the conference were helpful in the revision. Paper II was first presented at EUROMA 2022, after which it was completely rewritten in the current format. The paper has been expanded to be more comprehensive in terms of detail and analysis. There were certain validation meetings and workshops with company representatives during which the data were updated. Paper III will be presented in the upcoming EUROMA 2024. The intention was to have the same set of cases as Paper II, but due to interview scheduling problems, only one case could be included in the conference version. Paper III will be expanded after the conference with the other two cases that were used in Paper II.

3.3 Reflection on Quality

Validity is defined as "correctness or credibility of discussion, conclusions, explanation, interpretation" (Maxwell, 2013, p. 144). Instead of following methods during data collection, the idea is to think about the threats that could occur and then take action against them (Maxwell, 2013). Various threats in both papers are related to different stages of the study, such as setting up the study, data collection, analysis, and writing. In the first stage, one threat could be a lack of theoretical understanding of the topic. This threat has been mitigated, as the literature review was not interrupted at any time. There was a continuous review of the literature along with data collection and analysis. Thus, even if important literature was missed, it could be added later, and the model further developed. During the data analysis for the integration paper, it became obvious that only integration related to S&OP had been analyzed so far. Thus, integration within operations management related to other topics was incorporated into the paper. In the resilience paper, during finalizing, another literature search was conducted to update the literature framework, as many papers on resilience were published during that time; hence, it was important to remain updated with the latest publications.

During the data collection, one risk was whether the participants were telling it as it was. They could focus on sharing things that would place them and their organizations in a good light. Thus, if there was a struggle, it would only be shared if they had overcome it. Their failures were, for example, not mentioned to the same extent. I think this was inherent, and nothing could be done to make them admit their mistakes. As this study focused on how to overcome resilience and improve integration, focusing on the positives was a good thing. However, information about what did not work in their organization and context could have also added more depth to the data collection. Another way this was dealt with was to ask the respondents to narrate what happened during the disruption or during the S&OP process instead of asking specific questions. This would result in them explaining what happened and what they had done instead of leading them in a certain direction. Internal validity was enhanced by the use of multiple respondents. In the resilience study (Papers II and III), there were multiple respondents in the same interview, which allowed the respondents to complement each other and provide information. In the case of the integration study, there was only one "key informant" for the data; two interviews were carried out and a third interview was held in which the data were presented back for validation. The semi-structured

interview format was also helpful, as it allowed for follow-up questions on certain topics. This could mean that there was bias from the respondent. Nevertheless, the study design allowed for learning about integration, both within and across cases.

One way to ensure rigour is by participating in the research over a long period of time (Voss et al., 2002). This was done in this case by spreading the data collection and analysis over a relatively long period of time. This allowed us to revisit the data and literature. If data were missing or additional clarification was required, the organizations were contacted for the information. During this time, there was also constant discussion with the co-authors about the analysis and further refinement of the results from the paper. The results of both papers were presented at conferences as well as at workshops organized among the organizations present in the study. These events helped improve the data analysis and the relevance of the paper.

Another aspect is the change in the direction of the papers during the study. The integration paper was initially planned as a paper on the role of technology in improving integration. The interviews showed that the use of technology was not facilitating integration, and there were different challenges in different steps of the process. That is, the study changed its direction to investigate integration within each step of the process rather than the role of only technology in the S&OP process. This study also involved adding three more cases to add more depth to the results. Similarly, the paper on resilience initially focused solely on the S&OP process in improving resilience. However, this was changed when it was revealed that multiple processes worked together towards resilience rather than a single process. Here, one case, Sigma, was removed from the analysis, as the data collection in that case was not as detailed and extensive as in the other three cases.

Another aspect is the external validity present in the case studies (Voss et al., 2002). This was mitigated by studying multiple organizations. Generalising the results is often a difficult topic in case study-based research. This is even more compounded by the fact that this study was dependent on the COVID-19 disruption, where the results are applicable only to the specific context. Another attempt at generalizing was through the reduction of complexities in the papers. In particular, the paper on integration contained many concepts and terminologies that were not easy to understand. This was realized during the conference, and more work was put into reducing the complexities and terms while retaining many of the results. Nonetheless, the findings and results are useful for organizations in improving resilience. A general theory about resilience might not emerge from this work, but the results have the potential to complement existing findings about resilience.

Overall, this has been a long study with many changes along the way, with many data and literature added as well as removed. While this shift has improved the quality in certain ways, it has also delayed the finalization and publishing of the results. Quality is a function of the time invested, and it has been difficult to determine when to stop the data collection and analysis.

Chapter 4

Summary of Papers

In this chapter, a summary of the three Papers are provided. Table 4.1 provides a quick glance about the Papers.

4.1 Summary of Paper I

S&OP is a process that brings together different functions of organizations to create a common supply-and-demand plan. A few studies conceptualize integration in the S&OP process, but they treat the S&OP as a single process. Instead, S&OP is composed of various sub-processes that have different functions and have different requirements when it comes to integration. The purpose of this paper is to explore the integration requirements of the different sub-processes within the S&OP process. This investigation was conducted using a multiple case study methodology. S&OP managers at five different organizations—pharmaceutical (P), confectionary (C), telecommunication (T), medical equipment (M), and automobile (A)—were interviewed. In addition, S&OP process documents were collected to understand the process in detail. All the companies have established an S&OP process that they have run for several years. The data were then analyzed based on the different S&OP sub-processes: demand planning, supply planning, pre-S&OP, and executive S&OP.

Each case implemented the S&OP process in a unique manner. In the demand planning interface, coordination was involved in collecting and demanding information from various sales regions. In some cases, the finance function was involved, while the executive function was involved in other cases. In the supply planning sub-process, coordination was sufficient if specific manufacturing was carried out at a specific location, while collaboration was required if there were multiple manufacturing locations for the same product. The pre-S&OP process mostly involves coordination, as it is the aggregation of different demand and supply plans. Finance was involved in some cases to improve alignment. Coordination was also required in the executive interface, which also provided alignment to the process in terms of input to the next S&OP cycle.

The degree of integration varied between the cases and between different sub-processes in their S&OP process. The identified characteristics at each sub-process were the extent of cross-functional involvement, the type of cross-functional involvement, and the extent of local–global intra-functional level. Coordination was a fundamental aspect of integration in the organizations' S&OP processes. This allowed different functions at different hierarchical levels to exchange information. Nonetheless, some collaboration existed between functions where there was no coordination.

This was observed in smaller organizations where fewer functions were involved and where it could be easier to develop such collaboration. To achieve higher maturity levels in the S&OP process, collaboration is required. Active alignment, characterized by continuous alignment, varied based on the involvement of executive functions in the sub-process. Otherwise, alignment occurred at the end of the S&OP process, where the executive team set the direction for the organization. Integration differences informed the development of a maturity model for the S&OP process, ranging from basic coordination to the highest maturity level, encompassing coordination, collaboration, and alignment.

This paper showcases how S&OP integration differs in different cases. The paper contributes in terms of unifying all the different concepts in terms of integration. Furthermore, a maturity model for S&OP integration was established.

4.2 Summary of Paper II

The purpose of this paper is to understand how different supply chain planning processes lead to resilience. The COVID-19 pandemic and semi-conductor disruption have had huge effects on carious companies. These disruptions were used to understand how the various planning processes within the organization were used to tackle the disruption. As the creation of a demand and supply plan is the first step in an organization to navigate a disruption, it is necessary to understand how the SCP process can be set up to handle the disruption.

The study was carried out by interviewing three organizations—Alpha, Beta, and Gamma—about how they carried out the SCP during the disruption. Before the COVID-19 pandemic, Alpha had a regular monthly S&OP process and a weekly S&OE process. Alpha managed its disruption by using its existing S&OE process and adding frequent meetings and forums to replan its operations. A second process called Business Continuity Planning (BCP) was also introduced with a long-term focus. This was a weekly process at the beginning, which was later changed to a monthly process when the severity of the disruption decreased. The purpose of the BCP process was to be proactive about the long-term effects of the COVID-19 pandemic disruption and to create backup production sites, inventory, and transportation. Before the COVID-19 disruption started, Beta also had a monthly S&OP process, weekly S&OE, monthly supplier meetings, and weekly crisis supplier meetings. During the disruption, they continued with their existing processes but found it necessary to have a new reactive S&OE process directed at the disruption. The reactive S&OE process consisted of three sub-processes. The first was the production planning process, which was carried out daily. Based on the latest information about material supply, factory status, and customer requirements, the production plan was updated daily. The second sub-process was with the markets, where decisions were made about which customers to serve and prioritize. This was done twice a week. Management review was the last sub-process carried out once a week, during which performance was assessed and upcoming issues were highlighted. In the case of Gamma, monthly S&OP meetings were held before the COVID-19 pandemic. There was also a monthly Takt meeting that would handle issues in the 1–3 month horizon, similar to the S&OE meetings in other companies. When the disruption started, Gamma stopped its existing S&OP and Takt processes and instead replaced them with a reactive S&OE process. The reactive S&OE process consisted of a production planning process followed by material planning process,

which was then followed by a management meeting, where final decisions are made. This was carried out daily at the organization to manage the disruption. Beyond the processes at each company, multiple teams were created to analyze specific areas of the supply chain, such as procurement, where they liaised with suppliers to get deliveries of components. These teams then input their data into the processes by which decisions are made.

Short-term S&OE-like reactive processes, were the main way to handle disruptions at these organizations. As there were many uncertainties that were changing day to day, a daily process was required. A monthly or weekly frequency was certainly insufficient during the COVID-19 pandemic and semi-conductor disruptions. The S&OP process was useful in setting the direction of the S&OE process by having a long-term focus on demand and supply volumes. In terms of coordination, the reactive processes were well defined and organized, with clear goals and defined roles. However, IT tools were lacking, as many of the work and analysis were carried out using Excel. There was commitment from people and top management towards the disruption, which also played an important role in mitigating the crisis. Resilience capabilities, such as flexibility and agility, were generated from the SCP process. Alpha could also generate redundancy though the BCP process, but it was a long-term strategy. Otherwise, redundancy was derived from excess inventory and production capacity. Collaboration was a necessary component of resilience which created through the organization's SCP process. Collaboration was also required with suppliers and customers to mitigate the crisis.

This study showcases how different organizations have used their SCP processes to handle disruptions. The nature of disruption and its effect on the organization determined how the disruption was handled. The existing S&OP and S&OE process were not sufficient to handle the COVID-19 pandemic and semi-conductor disruption and required frequent and daily cross-functional replanning.

4.3 Summary of Paper III

The purpose of this paper is to understand how organizations can transition from a normal state to a disrupted state and then to a new normal state. Many capabilities for an organization are considered in a normal state that enables it to face a disruption, but one that is important is the ability to respond to the disruption by transforming itself. One such area of transformation is the SCP process in the organization. The transformation of SCP under these circumstances has not been studied; therefore, the purpose of this paper is to understand the capabilities required to achieve this transformation.

Semi-structured interviews were carried out with Beta and served as the main source of data collection. Some of the data were collected in 2022, when the organization was under semi-conductor shortage disruption. Additional data were collected after the organization emerged from the COVID-19 pandemic and semi-conductor disruption in 2024. The interviews were carried out with managers and employees involved in the disruption.

Beta underwent many changes during the transition to a disrupted state. One change was the addition of different processes, such as daily production planning, customer planning, review meetings, and sales crisis meetings. To execute the changes, they also required the ability to move orders due to lockdowns and lack of material

availability, as well as change order specifications due to semi-conductor shortages. The existing SCP process underwent a change in focus during the disruption. In the post-disruption state, many of the processes were retained with certain modifications. The main change would be a lack of top management participation in these processes. The S&OP and S&OE processes were then moved back to their previous roles in the organization. These changes were analyzed from the people-process-IT perspective.

Process-wise, the main change would be adding a new process or modifying an existing process. New processes were added in this case, which resulted in the existing process being modified implicitly. These new processes increased agility in decision making due to uncertainties. After the disruption, these processes were retained with slight modifications. They did not have the same importance as during the disruption and now serve as information-sharing sessions.

The people perspective involved the top management and employees who were invested in the process to manage the disruption. Top management decision making was used to make these process changes during a disruption; however, after the disruption, this capability was not used. Employees who worked during the disruption also gain experience and knowledge by working in a disrupted state, which is required in the future when a new disruption arises. New collaboration links were created between different functions that were maintained after the disruption because of the benefits it provided in terms of information sharing.

On the IT side, the in-house IT support enabled Beta to get quick fixes and changes to the system as required. Bigger changes in the IT system, such as advanced analytics systems, may not be possible in a short time. It is important for close collaboration with the IT team and for the IT team to know how the business operates in order to support operations with certain tasks during disruptions. In the post-disruption, these learnings and shortcomings could be used to develop new systems to be better prepared for the next disruption.

This study contributes to the capabilities required for the transition of organizations' SCP processes during resilience. As many studies focus on the capabilities required, there are seldom studies on how to achieve those capabilities during a disruption. This study demonstrates how achieving this transition requires a fit between the process-people-IT.

Table 4.1: Summary of Papers included in this thesis

	Paper I	Paper II	Paper III
Title	Cross Functional Planning for Sales and Operations Planning (S&OP) Process Integration: A Multiple Case Study	Resilience through routine and reactive supply chain planning processes	Transition of Supply Chain Planning Processes during Disruptions
Purpose	Explore the integration requirements of the different sub-processes within the S&OP process	Understand how different reactive and proactive SCP processes lead to resilience	Understand how organizations can transition their SCP from a normal state to a disrupted state and then to a new normal state
Research Design	Multiple Case Study with five cases – P, C, T, M, A	Multiple Case Study with three cases Alpha (or T), Beta (or A), and Gamma (or M)	Single Case Study with Gamma (or A)
Main Findings	Coordination is present in different sub-processes while collaboration is limited and only found in sub-processes with similar functions. Alignment occurs at the end of the process but can also be created with participation of upper management in each sub-process. An S&OP maturity model is created based on the level of coordination, collaboration, and alignment.	The findings show that disruption was mainly handled through the reactive S&OE process with the support of S&OP process and other ad-hoc processes. This created flexibility and agility in the organizations. The S&OP process provided direction to the short term process. In addition, other resources like knowledge, redundancy, information sharing with customers and suppliers were required in creating resilience.	There were many changes in the organization during the disruption which requires the ability to add or modify processes. Top management was involved in the decision making and setting up the process during the disruption, while the employees gained experience which they retain after the disruption. IT changes were limited but required close working between operations and IT teams to make the changes possible.
Conclusions	The study contributes to existing S&OP frameworks by conceptualizing and exploring S&OP sub-process and S&OP integration as a construct.	The study highlights the need for regular and reactive SCP processes, and the implications of configurations, coordination, and resource combinations in resilience.	This study highlights SCP process-people-IT capabilities required to transition SCP during uncertainties. This allows organization to develop dynamic SCP process.

Chapter 5

Results

In answering the RQs, the results from different papers have been used. Paper I was used in mainly RQ1 and to a small extent in RQ3. Papers II and III were used in both RQ1 and RQ2. Figure 5.1 depicts how the different papers were used to answer the three research questions.

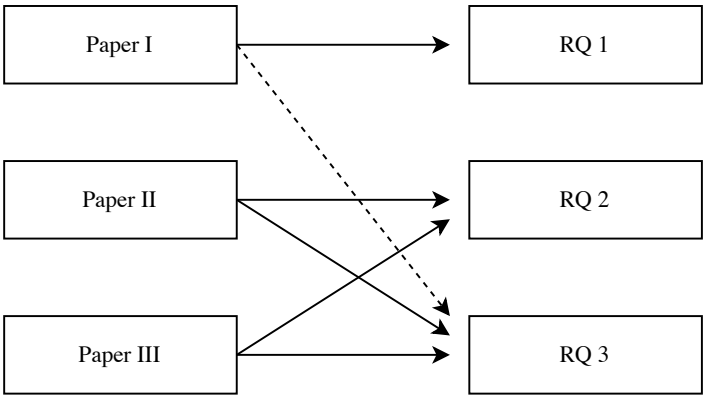

Figure 5.1: Contribution of each paper towards the RQs

5.1 RQ1: How does cross-functional supply chain planning lead to Integration?

Integrating different functions in the organization is difficult, as different functions have different objectives. An S&OP process is a cross-functional planning process that requires several functions to coordinate, collaborate, and align to break down silos and ensure that all departments are working towards a common objective, ultimately leading to improved efficiency and effectiveness. One of the first steps toward integration is to define what it is.

There are several definitions and terms associated with integration. With S&OP, integration can be thought of as composed of three different components: coordination, collaboration, and alignment. S&OP emphasizes the importance of coordination. This is usually the first step in establishing an S&OP process, which is to define the roles and responsibilities of each team involved. Thus, the creation of S&OP can lead to coordination between the different functions, in which they exchange information with each other.

Within each sub-process in the S&OP, there are forms of collaboration. This type of collaboration is easy within the functions of various hierarchies. For example, collaboration between sales at the market and global levels is present, but collaboration between sales and supply planning might be more challenging due to conflicting priorities. However, achieving collaboration between these functions could help in creating a plan that balances demand and supply in the best way for the organization.

Alignment with the overall company goals and objectives is achieved through the S&OP process through the participation of executive management in the process. In some cases, it is observed that executive management also participates in each of the sub-processes so that alignment is created at the various sub-processes. Alignment with the operational level is ensured through the S&OE or similar process, which allows for timely adjustments based on real-time data and feedback. The S&OE process also needs to be cross-functional and integrate the various functional areas of the organization, similar to the S&OP process. As the planning process moves from coordination to collaboration to alignment, it can help break down silos and improve overall efficiency and productivity.

5.2 RQ2: How can cross-functional supply chain planning processes change to adapt to disruptions?

Organizations face different disruptions, which can be hard to mitigate before they occur. As disruptions happen suddenly and have various effects, the organization needs to change its existing processes to manage the disruption. Different changes to the process and ways of working occur, and cross-functional planning SCP processes are no exception. The changes concerning people, processes, and IT should fit the context in which the organization finds itself.

As disruptions involve daily changes, they require a process that can handle these changes daily and make decisions and plans. An S&OE process with a daily frequency can be implemented, or an existing S&OE process can be run with a higher frequency. This requires capabilities related to adding and modifying processes. This is derived from top management decision making as well as previous experience with similar disruptions. This affects how new processes are created or modified during a disruption. These new processes would also require new ways of working to which employees must adapt. Adding new responsibilities and processes over existing ones, as well as increasing frequency, would increase the workload and output required of the various planners. Here, a balance is necessary to assess whether the existing process needs to be continued in the same way as before. Due to the urgency of the disruption at hand, the new process would receive a considerable amount of attention compared to regular processes. However, the existing process, such as S&OP, is still necessary to provide long-term supply and demand numbers to the reactive process. The IT system also needs to change to enable these changes in the planning process. The IT system can hinder the new ways of working as it is designed based on established business logic. As organizations need to work in a different way during the disruption, this would mean overriding the IT system, which can be done with support from the IT team if it is familiar with the business process and setup of the system. A lack of collaboration and knowledge between IT and operational teams can affect agility during disruptions.

After the disruption, there are also changes to the cross-functional planning process. These ad hoc processes are not removed but rather slightly modified. Top management no longer participates in the process but now the employees have gained experience in handling the disruption. The employees carry out these new processes, which now serve as information-sharing sessions and are proactive about upcoming challenges. It is difficult to predict whether these processes will continue indefinitely or whether the organization will be able to deal with disruptions actively or reactively. A similar disruption could perhaps be handled, but a new disruption with a different effect on the supply chain might require an additional ad hoc process to be created or at least an ad hoc task force team at a minimum. The IT process, by virtue of not having undergone any changes during the disruptions, does not require any changes after the disruption. However, many tools and ways of working developed during the disruption would come in handy in the future when similar requirements arise. Another way to develop the IT process would be to implement these changes in the process, such as data gathering and scenario analysis, which could facilitate a better reaction to the crisis.

5.3 RQ3: How does Cross-Functional supply chain planning contribute to resilience?

Resilience in an organization is created through various capabilities. The cross-functional planning process is an essential component of building these capabilities. It contributes to resilience by generating flexibility and agility in responding to unforeseen challenges and changes in the environment. For this, various configurations of the planning process are required. Large disruptions, such as COVID-19 and semi-conductor shortages, require the creation of new processes that can adapt quickly to rapidly changing circumstances. These processes are carried out daily, as the situation in the organization changes a lot from day to day. They provide agility and flexibility by updating plans daily. The ad hoc cross-functional planning process can be an effective way to mitigate the disruption but is required only if the regular cross-functional planning processes are not sufficient to handle the disruption. The respective functions or the S&OE process in an organization frequently handle many daily disruptions. Only in the case of large-scale disruption would an integrated effort of the organization and supply chain be required to mitigate the disruption.

This reactive process can be modelled based on the existing S&OE process within the organization, or a new process can be created ad hoc. The decision of which approach to take depends on the maturity of the S&OE process. If the S&OE process is well established and can make high level decisions, then the same structure can be extended to the daily frequency instead of the weekly frequency of the S&OE process. The frequency required depends on the type of disruption and how often the information changes. In the case of the COVID-19 pandemic and semi-conductor disruptions, a daily reactive planning process was used at the organizations. The daily process also requires four links at a minimum: a link to the supplier side, a link to the customer side, a link to internal operations, and a link to the executive team. To guide the reactive process, long-term supply and demand plans from the S&OP process are required. This ensures that the process stays on track as per customer requirements and is aligned with the long-term requirements of the organization. Plans developed

in the S&OP can also be used to provide suppliers with information related to future volumes. This improves collaboration with suppliers. On the customer side, S&OP can prompt a more accurate understanding of the customer's long-term requirements. Instead of focusing on the short term, resilience can also involve tackling the long term. For example, the COVID-19 pandemic and semi-conductor shortages have been long-lasting disruptions. Instead of just focusing on the near term, it can be beneficial to be proactive and plan various redundancies for the future, considering the present scenario. Here, the S&OP plans could direct the long-term redundancy plan Integration between the different processes is required. There is coordination among the different task forces and planning processes that are created. They also collaborate closely with each other to create good solutions for their organizations. The four links ensure that the various parts of the supply chain are accounted for. The executive team is present in these processes to ensure that quick decisions are made and that delays in executing them are minimized. Alignment with long-term objectives also comes from anchoring the process with respect to the S&OP process.

Chapter 6

Discussion

Organizations are designed with different functions, and integration across these functions is required to achieve higher performance. SCP requires both the demand and supply sides of the organization to be in sync to create a common set of plans. This has resulted in S&OP being a key process in manufacturing organizations today. Theoretically, S&OP has enabled the integration and creation of a single set of plans for the organization (Grimson & Pyke, 2007), and the performance benefits of the same have been demonstrated by Goh and Eldridge (2015) and Thomé et al. (2014). Although Paper I does not go into the performance aspect, it does highlight the challenges and enablers for integration, especially with organizational design, such as global footprints affecting integration. These are not taken up in the current integration model by Tuomikangas and Kaipia (2014) or in the maturity model by Danese et al. (2018). The global footprint also further fragments functions across regions, which makes integration challenging. Moreover, Goh and Eldridge (2019) discovered differences between S&OP performance outcomes and integration mechanisms for different regions. Nonetheless, collaboration, and alignment between the same functions across regions is easier than across functions due to the similarities in objectives in the same functions. Therefore, one organization with operations in different countries also requires differences in how S&OP is set up and run. Here, coordination between regions and functions can enable integration.

The question remains whether coordination between functions is sufficient. Another question to tackle here is the level of integration required. The accepted position is that the higher the integration in the organization, the better the performance. It is possible that the highest level of integration is not always required across all functions. Having only coordination (i.e. data exchange in one direction), might be sufficient to create a good plan. For example, in a normal state, the purchasing department would require only a component list, and their coordination with operations would be acceptable. However, in a different situation, such as the COVID-19 pandemic, where there is a lack of components, collaboration and alignment are required between purchasing and operations to create a good outcome. Therefore, the level of integration required depends on the context and it is not always desirable to achieve the highest level of integration. The context can change due to disruptions that require different types of integration.

During a disruption, organizations require agility and flexibility to be resilient (Christopher & Peck, 2004). A disrupted state would require a dynamic S&OP, in contrast to a stable procedure (Jonsson et al., 2021). A survey by Goh and Eldridge

(2019) also revealed that fixed procedures inhibit supply chain performance and instead suggest organizational bricolage to improve performance. The COVID-19 and semi-conductor disruption in Paper III did not indicate a need for the S&OP process on the whole to be modified. The S&OP processes were run as they were. Some parts of the S&OP process could be repurposed and run at a higher frequency; for example, the demand planning was run weekly by Beta, as indicated in Paper III. This also indicates the need to study integration within each step of the S&OP process rather than looking at it as a whole, which was the aim of Paper I. In Beta, integration in one step of the process was increased temporarily by adding collaboration and alignment.

The biggest change in the SCP process at the organizations came from the reactive S&OE process. Dittfeld et al. (2021)'s suggestion to modify the S&OP design by increasing the frequency or changing the planning horizon was not carried out here. The disruption had a near-term impact, and the reaction to the disruption should have also matched that. S&OP has a different role in organizations, which is to match demand and supply in the medium term (Grimson & Pyke, 2007), and that was what Alpha and Beta continued to do. If there were changes to the supply and demand in the medium term, it could be well handled in the S&OP process. The S&OE process is an important process that is complementary to the S&OP process, and more research is needed to establish it as a legitimate and necessary process as the S&OP. This study, however, shows how the S&OE plays a vital role in managing during disruptions.

The literature has identified a multitude of capabilities that contribute to an organization's resilience. Flexibility, agility, collaboration, and redundancy are some of the broad ones (Tukamuhabwa et al., 2015). The three cases examined in Paper III demonstrate that the cross-functional planning process is capable of flexibility, agility, collaboration, and redundancy to improve resilience. At the same time that integration occurs within the process and redundancy is an input towards the SCP process, the process itself produces the outcomes of flexibility and agility. This model is explained in detail in Paper II. Recall that during disruptions, both short-term and long-term planning are necessary; as a result, a combination of several processes drives the response to disruptions. Therefore, there is little doubt that resilience results from the capabilities of SCP processes during a disruption. In addition, the SCP process offers capabilities both before and after a disruption. Coordination with suppliers and customers results in the latest information being incorporated into the process. This is referred to as visibility, which is another capability required for resilience derived from collaboration (Scholten & Schilder, 2015). To proactively manage risks, Kalla et al. (2024) also suggested that risk monitoring should be a regular component of the S&OP and S&OE processes. An SCP process contributes to resilience in the post-disruption state by learning from experiences during the disruption. This makes the SCP better at detecting and responding to disruptions.

The purpose of this research has been to develop the understanding of how to improve integration and resilience through cross-functional planning. This can be summarized in the Figure 6.1. In a normal state, the cross-functional processes, mainly the medium-term and short-term processes, integrate the different functions within the organization to create a united plan for the organization. This integration is achieved mainly through coordination, but collaboration and alignment can be used where it is beneficial to do so. These processes also include certain risk management, with the organization being able to plan as per the risks that are identified in the process. If disruptions occur, then the organization moves to a disrupted state. Here, there are

certain modifications to the SCP processes. Certain sub-processes can be carried out at a higher frequency, and higher integration can be enabled in certain sub-processes. Where integrations do not exist earlier, they can be created through a new ad hoc process. Thus, the organization can be agile and flexible to improve resilience. After the disruption, the organization can go back to its previous state of working but with improvements, so that similar disruptions are avoided in the future

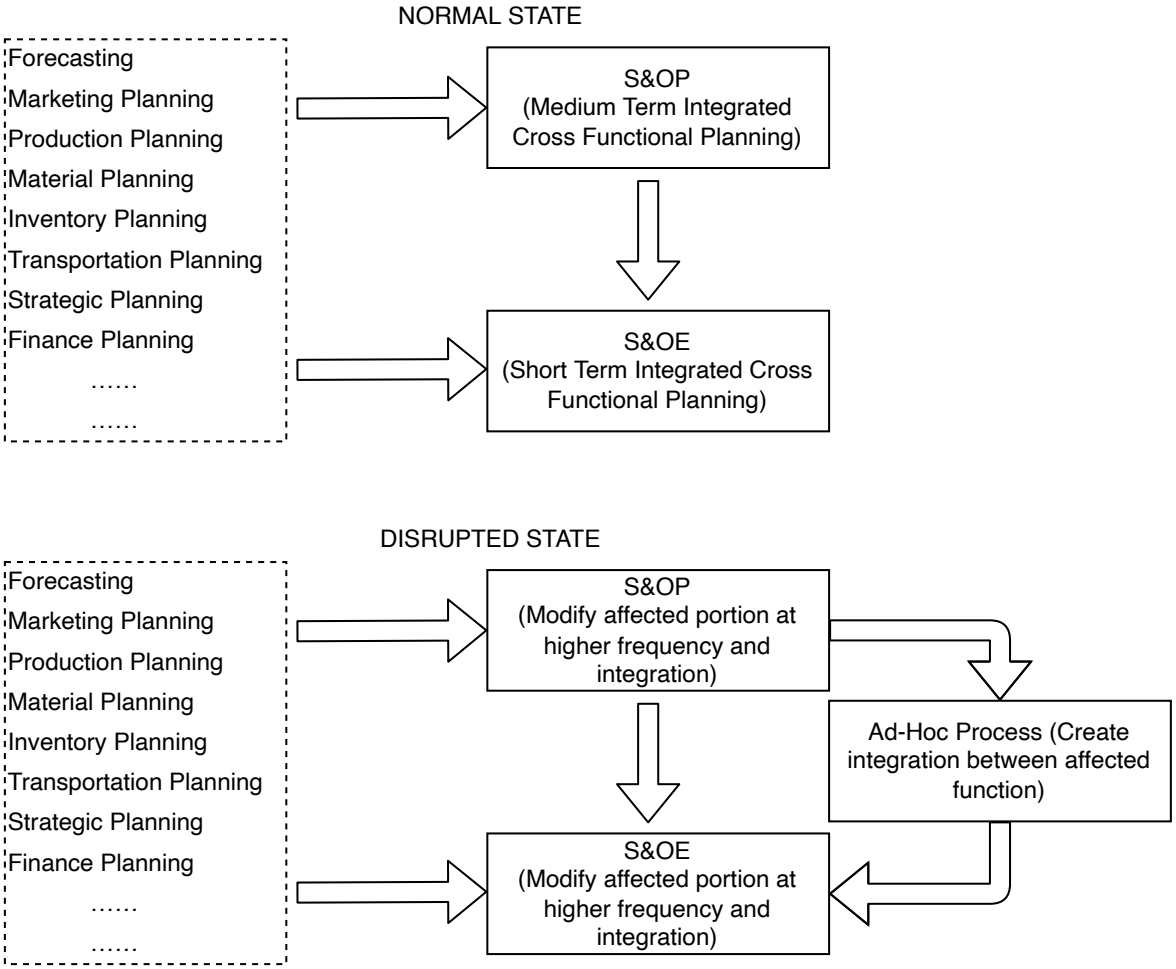

Figure 6.1: Depiction of Integration of SCP Process in Organizations during Normal and Disrupted State

Chapter 7

Conclusion

In the fast-paced world of supply chains, where disruptions are becoming more common and frequent, organizations must constantly adapt to and plan for the future. This study explores the opportunity to use the supply chain planning process to develop resilience. The findings suggest that successful cross-functional supply chain planning promotes intra-organizational integration and contributes to resilience.

7.1 Theoretical Contribution

By elaborating on the work of Tuomikangas and Kaipia (2014), this study develops the concept of integration within S&OP. The S&OP process is explored further from the individual sub-processes within it to understand the integration requirements within each process. In exploring the S&OP process, definitions of the terms coordination, collaboration, alignment, and integration are clarified, which should remove ambiguity for future researchers using this term not only within the S&OP context but also for concepts across the supply chain. An alternate model of S&OP development is also provided that emphasizes integration between the different functions and in terms of functions that are part of the process.

This work also builds on the various resilience models that have been developed (Ali et al., 2017; Christopher & Peck, 2004; Tukamuhabwa et al., 2015). By analyzing SCP during resilience, the importance of a good integrated SCP process for resilience is highlighted. Changes in organizational activities and the importance of flexibility and agility are emphasized. Departing from the various known modes of flexibility and agility, this research positions SCP as an alternative means of achieving flexibility and agility and thereby creating resilience.

Lastly, the influence of context on integration and resilience has also been a part of this research. Contextual information is necessary to achieve successful implementation of the SCP process (Kristensen & Jonsson, 2018). Global supply chains are the norm today, and the challenges associated with their integration are highlighted in this research. The disruption also affects the overall efficiency and effectiveness of the supply chain. Understanding the context in which supply chain processes operate is crucial for organizations to adapt and respond to changes quickly and effectively. This research underscores the importance of context in supply chain management and the need for organizations to respond accordingly.

7.2 Managerial Implication

This research has certain managerial implications. The integration maturity model outlined in Paper I provides a framework for organizations to gauge their level of integration between functions and the S&OP process. By understanding the level of integration, organizations can identify areas for improvement and work towards achieving their objectives more effectively. Through the successful implementation of S&OP and a mature integration process, organizations can optimize their operations and navigate disruptions with greater agility and efficiency. This research highlights the crucial role that S&OP plays in enhancing business performance and resilience in today's dynamic marketplace. In addition to the S&OP process, the S&OE process is important in today's organizations. Implementing an S&OE process can improve integration and provide proactive risk mitigation. Adapting and utilizing the SCP process also provide a reactive disruption response. While implementing changes, the organization also needs to adapt according to the context. By incorporating both S&OP and S&OE processes into their operations, organizations can establish a robust framework for decision making that aligns with their strategic goals. Ultimately, investing in integrated planning processes, such as S&OP and S&OE, is essential for organizations looking to thrive in today's fast-paced and unpredictable business environment.

7.3 Future Research

Technology did not play a very vital role in any studied case. One reason is that a relative level of advanced technology usage in the SCP was low in all cases. However, technology could pave the way for organizational resilience in the future. It may become easier to share data and analyze data across functions through the use of technologies, such as big data and machine learning. Big data analytics can assist in making efficient decisions (Xu et al., 2021). Technology could also provide help with visibility as well as automatic replanning as per the latest information. This might require the development of a scenario analysis and digital twins in the S&OP process (Jonsson et al., 2021). Future studies could investigate how technology could contribute in various ways to improving S&OP and S&OE processes, as well as supply chain resilience.

Supply chain resilience is a network-wide endeavour. While this research has identified customers and suppliers as resources required for generating resilience, they were not explicitly within the scope of the study. However, increasing the scope of the study to include other actors outside the organization could provide information about how these customers and suppliers contribute to the SCP and the creation of resilience. Such efforts may provide insights into specific resources within the supply chain that could improve coordination and resilience. Technology could also assist in improving coordination across the supply chain.

The COVID-19 pandemic disruption itself had a big impact on the study. As the disruption was focused on the COVID-19 pandemic and the related semi-conductor disruption and organizations within Sweden, the results require further testing in other contexts. The replication of this study and verification of the results in other contexts would be helpful in developing a robust model of SCP and resilience. In addition to other contexts, the cost to organizations was not analyzed in this research. Analyzing this is helpful in deciding the appropriate actions to take during a disruption. Also, organizations that have an S&OP process were used in this study. The study of smaller

organizations that do not have the resources to invest in S&OP and S&OE could highlight differences or alternate paths to reach resilience.

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