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# FRAMEWORK FOR SALES AND OPERATIONS PLANNING IN ENGINEER-TO-ORDER ENVIRONMENT

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# ABSTRACT

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In recent years, sales and operations planning (S&OP) has become an integral part of the supply chain functions in many organizations. S&OP is seen as a way to create organizational alignment with the operating strategy and as a result improve revenue, decrease inventory levels and reduce costs. Thus, its positive effect on company's performance has clearly been noticed. Despite the growing practical interest towards the implementation and execution of S&OP, the research around the topic has focused on consumer goods or pharmaceutical industry and on Make-to-Stock (MTS) environment.

This master's thesis studies the execution and best practices related to S&OP in industrial manufacturing in Engineer-to-Order (ETO) environment. The goal of the research is to develop a framework for the execution of S&OP for companies operating in ETO context. In addition, a deeper understanding is sought on the factors that create the need to customize S&OP based on the requirements of ETO environment. These objectives were addressed by first developing a framework related to S&OP execution in MTS environment based on the current academic literature. Through an empirical study, the assumptions of the framework were tested by interviewing S&OP process stakeholders within an organization operating in ETO environment. This provided a chance to gain understanding on how S&OP is carried out in the context of ETO and what are the similarities and differences compared to S&OP in MTS environment. Based on these findings, the initial framework was modified to the needs and requirements of ETO context. As a result, an execution framework for S&OP in ETO environment was created. The framework constructed passed the weak market test carried out in this research and is being implemented in the case company.

The findings of this study imply that there are differences in the execution of S&OP between MTS and ETO environment and, hence, the processes should be managed differently. It was evident that S&OP should be customized according to the requirements of the business environment. The found factors with the greatest impact on the need to customize S&OP in ETO context are fluctuating demand, difficulty to forecast and wide and complex product portfolio. Due to the existence of these factors, there is a need to place high emphasis on demand planning, scenario analysis and strategy and risk analysis as part of the S&OP in ETO environment. In addition, finance should be integrated as part of the process and the transparency of the process and decision-making should be secured. The framework constructed in this study provides opportunities for organizations operating in ETO environment to enhance their S&OP practices and, hence, ensure continuous competitiveness.

Keywords: sales and operations planning, Make-to-Stock, Engineer-to-Order, industrial manufacturing

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# TIIVISTELMÄ

Sanni Kymäläinen: Viitekehysten kehittäminen myynnin- ja tuotannonsuunnittelun toteutukseen ainutkertaisten tuotteiden tuotantoympäristössä  
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Myynnin- ja tuotannonsuunnittelusta on viime vuosina tullut olennainen osa organisaatioiden toimitusketjujen hallintaa. Myynnin- ja tuotannonsuunnittelu on nähty tapana integroida organisaation strategiset tavoitteet yrityksen operatiiviseen suunnitteluun ja siten mahdollistaa liikevaihdon kasvaminen ja varastotasojen sekä kulujen pienentyminen. Sen positiivisesta vaikutuksesta organisaatioiden suorituskykyyn ollaan samaa mieltä. Myynnin- ja tuotannonsuunnitteluprosessin implementoiminen ja kehittäminen kiinnostaa yhä laajemmin, mutta toistaiseksi tutkimus aiheesta on kohdistunut lähinnä kulutustavaroihin ja lääketieteellisuuteen sekä varasto-ohjautuvaan tuotantoon.

Tässä diplomityössä on selvitetty myynnin- ja tuotannonsuunnittelun toteutusta ja parhaita käytäntöjä siihen liittyen teollisten ainutkertaisten tuotteiden tuotantoympäristössä. Työn tavoitteena on luoda viitekehys myynnin- ja tuotannonsuunnittelun toteuttamiseen ainutkertaisten tuotteiden tuotantoympäristössä. Lisäksi halutaan ymmärtää tekijöitä, jotka vaikuttavat tarpeeseen kustomoida myynnin- ja tuotannonsuunnittelua toimintaympäristöstä riippuen. Työ alkoi kirjallisuuskatsauksella, jonka pohjalta kehitettiin viitekehys myynnin- ja tuotannonsuunnittelun toteuttamiseen varasto-ohjautuvassa tuotannossa. Tämän viitekehysten pohjalta työn empiirisessä osiossa haastateltiin myynnin- ja tuotannonsuunnittelun sidosryhmiin kuuluvia henkilöitä ainutkertaisten tuotteiden toimintaympäristössä toimivassa kohdeyrityksessä. Tämä lisäsi ymmärrystä, kuinka kyseisessä ympäristössä toteutetaan myynnin- ja tuotannonsuunnittelua sekä mitä samankaltaisuuksia ja eroavaisuuksia on nähtävissä verrattuna varasto-ohjautuvaan tuotantoon. Tuloksena syntyi viitekehys myynnin- ja tuotannonsuunnittelun toteutukseen ainutkertaisten tuotteiden toimintaympäristössä. Kehitetty viitekehys otettiin käyttöön kohdeyrityksessä. Se läpäisi tässä työssä suoritettua heikon markkinatestin.

Tämän tutkimuksen löydösten perusteella myynnin- ja tuotannonsuunnittelun toteutuksessa on selkeästi havaittavia eroavaisuuksia varasto-ohjautuvan ja ainutkertaisten tuotteiden toimintaympäristön välillä. On siis selvää, että myynnin- ja tuotannonsuunnittelua tulisi mukauttaa toimintaympäristön asettamiin vaatimuksiin. Ainutkertaisten tuotteiden tuotantoympäristön merkittävimmät myynnin- ja tuotannonsuunnitteluun vaikuttavat tässä työssä havaitut erityispiirteet ovat: vaihteleva kysyntä, ennustamisen vaikeus sekä laaja ja kompleksinen tuoteportfolio. Näistä tekijöistä johtuen kysynnän suunnittelua, skenaarioanalyysiä sekä strategiaa ja riskien arviointia painotetaan myynnin- ja tuotannonsuunnittelussa ainutkertaisten tuotteiden tuotantoympäristössä. Lisäksi tässä työssä todettiin tärkeäksi talouden integroiminen osaksi prosessia ja läpinäkyvyyden varmistaminen prosessin aikana tapahtuvassa päätöksenteossa. Tämän työn tuloksena syntynyt viitekehys mahdollistaa ainutkertaisten tuotteiden tuotantoympäristössä toimivien yritysten myynnin- ja tuotannonsuunnittelun kehittämisen ja siten kilpailukykyä parantamisen.

Avainsanat: myynnin- ja tuotannonsuunnittelu, varasto-ohjautuva tuotanto, tilauksesta suunnittelu, teollisuus

Tämän julkaisun alkuperäisyys on tarkastettu Turnitin OriginalityCheck –ohjelmalla.

## PREFACE

Writing this thesis has been the final spurt in my university studies. It has been a long yet unforgettable journey with all the great people I have had the privilege to meet. Now, it is time to start a new chapter in my life by taking a step to the working life. I cannot wait to start working towards my next dreams.

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## LIST OF ABBREVIATIONS

ATO	Assembly-to-Order
BA	Business Area
BLM	Business Line Manager
EBIT	Earnings Before Interest and Taxes
ETO	Engineer-to-Order
FI-S&OP	Fully Integrated Sales and Operations Planning
FOD	Forecast, Order & Delivery -process
FTE	Full-time Equivalent
IBP	Integrated Business Planning
IMS	Integrated Management System
MTO	Make-to-Order
MTS	Make-to-Stock
NPD	New Product Development
OI	Order Intake
PU	Production Unit
SCM	Supply Chain Management
S&OP	Sales and Operations Planning
WIP	Work in Progress

# 1. INTRODUCTION

## 1.1 Background

According to Wilson & Raman (2017) the rapidly changing business environment has increased planning complexity in the organizations. The increased complexity has led to the need to synergize more functional areas and make the planning cycles shorter. In order to survive in the competitive markets, concentration on supply chain management (SCM) is a must. The leading idea behind supply chain management is to gather around the different divisions of the organization and manage their processes and activities in a coordinated and efficient way (Alavidoost et al., 2018) while constantly developing and increasing coordination between the operational functions such as supply and demand (Ávila et al., 2019).

In multidivisional organizations, it is often that functional boundaries become barriers to success of the supply chain. Cross-functional problems can trigger issues like obsolete and excess inventory, complex product lines, poor forecasts and ineffective demand management (Stank et al., 2011). However, the greatest barrier to supply chain excellence is the inability to match supply with demand (Esper et al., 2010).

By focusing on the supply chain management approach to managing global operations, more emphasis on the inter-dependencies between the different functional areas within the company can be given (Nemati et al., 2017). In other words, centralized decision-making and control over the supply chain activities will be enhanced. In recent years, the concept of sales and operations planning (S&OP) has gained growing interest as a supply chain coordination, synchronization, value creation and integration mechanism (Nemati et al., 2017).

S&OP consists of two distinct parts: production planning and sales planning. Production planning takes into account issues such as capacity and inventory needs and restrictions as well as order backlog levels while sales planning considers demand situation and forecasting. (Olhager et al., 2001) The aim is to balance production capacity with demand and to create one coherent plan (Danese et al., 2018).

Roughly, there can be identified two ways to balance between demand and supply. Either the market demand will be changed to match the production limitations, or the production capabilities will be modified to answer the demand. The first one being called

as aggressive and the latter reactive approach. (Krajewski, 2016) In this paper S&OP is considered as a reactive tool to satisfy the demand.

The supply chain of an organization is built on a certain manufacturing strategy. According to Stevenson (2018, p. 673) there can be identified four different approaches to manufacturing: Engineer-to-Order (ETO), Make-to-Order (MTO), Assemble-to-Order (ATO) and Make-to-Stock (MTS). The different strategies vary on the ways the manufacturer is responding to customer orders. To put it simply, the less standard a product is and the more it requires customization the higher needs to be climbed in the manufacturing approach hierarchy. ETO requiring the most customization and MTS manufacturing products to finished goods inventory.

Despite the growing, both academic and practical interest towards S&OP, the literature around the topic is mainly focused on consumer goods or pharmaceutical industry and MTS manufacturing environment. Hence, this provides an intriguing possibility to research this topic further and extend the focus of S&OP to industrial manufacturing and ETO environment.

It has been noticed that even though S&OP has become an integral part of the supply chain function in many organizations, the benefits have not been realized in the extent wished for (Wilson & Raman, 2017). Broader understanding of the implementation of the process, its benefits and requirements, while taking into account the industry specific needs, would facilitate businesses in getting positive results out of the S&OP process. In addition, the increasing need to respond fast and holistically to market volatilities encourages managers to introduce and improve their S&OP capabilities in the hope of achieving and sustaining competitive advantage.

## **1.2 Objective of the Thesis**

The objective of this thesis is to create an execution framework for sales and operations planning process in Engineer-to-Order environment. In order to reach the research objective, the following research questions need to be answered:

**RQ1.** How is sales and operations planning defined in Make-to-Stock environment and what are the best practices related to its execution in the academic literature?

**RQ2.** What are the biggest similarities and differences between sales and operations planning in Make-to-Stock and Engineer-to-Order environment?

**RQ3.** What are the factors that drive the need for customization of sales and operations planning in Engineer-to-Order environment?

The first research question is answered by studying the academic literature around sales and operations planning in MTS environment. The key steps in the sales and operations planning process as well as the best practices related to these are wished to be identified. This information is then used to build an execution framework for sales and operations planning in MTS context, as a result of the literature review.

The second research question is answered through the empirical part of this research. Through interviews, observation and studying the company material understanding is aimed to be gained on the practices, tools, organization and corporate culture used to carry out the sales and operations planning in the case company as well as on the challenges faced in the execution of the process. After a comprehensive view of the process of the case company, it can be compared with the theory framework constructed in the hope of identifying similarities and differences between S&OP in these different contexts.

The third research question is answered by combining the identified unique characteristics for sales and operations planning in ETO context with the business environment specific characteristics of the operating environment in a matrix. Cause and effect relationships between these are looked for.

As a result of answering to the research questions above, the execution framework for S&OP in ETO environment can be constructed. Thus, the objective of the research can be fulfilled. S&OP is carried out on a local level in the case company, which means that the scope of this study is limited to the execution of local S&OP and global S&OP can be left out of the focus of this research. In addition, it should be highlighted that the scope of this study is only on developing a solution for carrying out S&OP in ETO context. Thorough testing of the solution in practice to demonstrate its effects on the performance of companies is not in the scope of this thesis.

### **1.3 Special Characteristics of Engineer-to-Order Environment**

This chapter presents the special characteristics of Engineering-to-Order (ETO) environment from the market and manufacturing point of view. In the end, it is also reflected how these characteristics affect the long-term planning in companies. Summary of the key characteristics identified is presented in Figure 1.

With ETO approach, the products are designed and built according to customer specific specification (Stevenson, 2018, p. 673) and because the product design is custom also the product variety is wide (Vollmann & Whybark, 1997, p. 365). The orders usually require detailed engineering after the order has been received and sometimes the orders

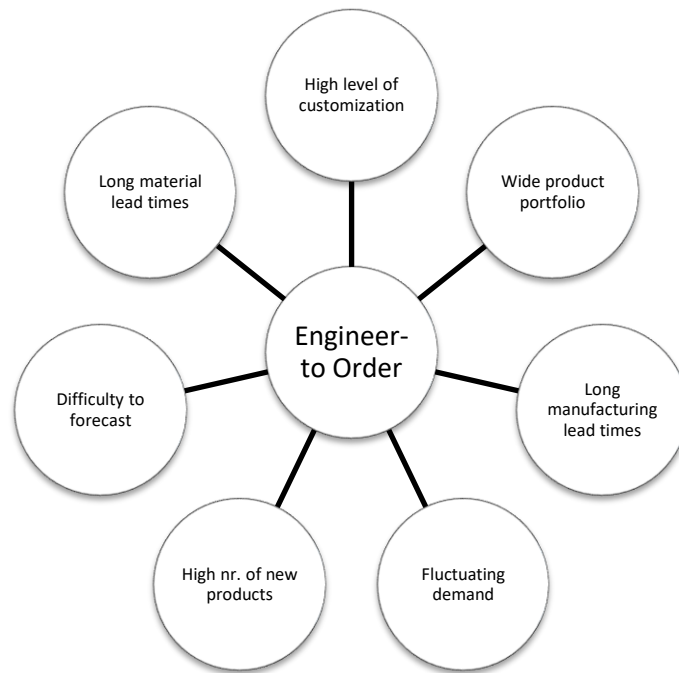
might not even be fully specified at the time of the booking (Vollmann & Whybark, 1997, p. 330). Hence, a lot of uncertainty is present regarding the orders.

A typical manufacturing process in ETO environment is low-volume job process (Vollmann & Whybark, 1997, p. 365). A job process refers to manufacturing with high level of in-built flexibility to produce high variety of products with considerable divergence in the process steps performed (Krajewski et al., 2016, p. 75). Delivery speed in the manufacturing process is achieved through overlapping scheduling of the different design and manufacturing activities. However, the reliability of the delivery is not considered very good because of the high level of customization in the manufacturing process.

One key characteristic of ETO environment is the fluctuations in sales volumes. This is usually managed through the relatively big order backlog level and flexibility actions in manufacturing. The fluctuations in sales volumes increases the importance of good forecasting but at the same time makes it demanding. Manufacturers following the ETO strategy tend to also have long manufacturing times as well as long material lead times (Vollmann & Whybark, 1997, p. 365). Hence, also the product lead times can be very long.

When looking at the competitive advantage of companies following the ETO strategy, it has been noticed that they have frequent new product introductions. In addition, they are usually very focused on developing and providing new product technologies. (Vollmann & Whybark, 1997, p. 365) These are the capabilities that keep them in the competition.

To summarize the findings (Figure 1) from the long-term planning point of view, it can be noticed that the factors that complicate the planning efforts in companies with ETO strategy are high level of customization, wide product portfolio, long manufacturing lead times, long material lead times, fluctuating demand, high number of new products in the portfolio and the difficulty of forecasting the demand. The level of uncertainty related to the ETO environment creates the need for flexibility both in planning and in manufacturing.

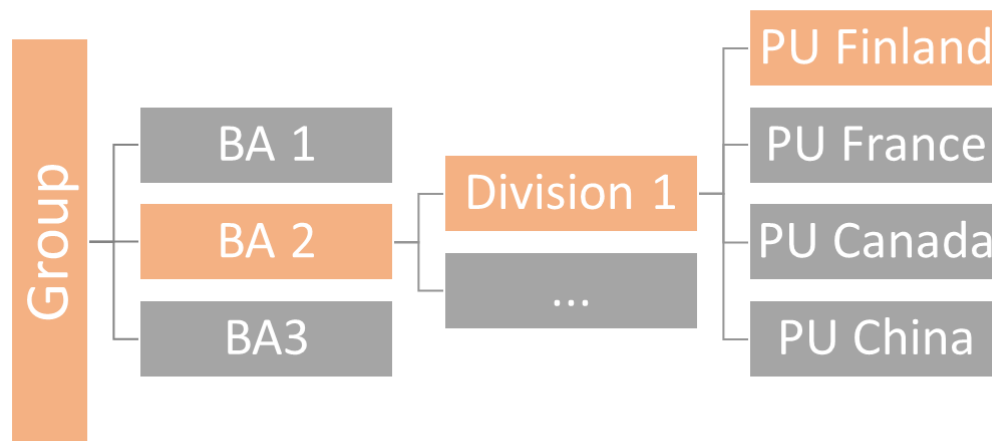


**Figure 1.** Key characteristics of Engineer-to-Order manufacturing environment.

From the perspective of S&OP, it can be expected that the special characteristics of ETO environment discussed above can influence the execution of S&OP when compared with MTS environment. In other words, it might be beneficial to customize the process according to the special characteristics of the manufacturing strategy adopted, which is the aim of this research.

## 1.4 The Case Company

The case company is a global high-tech engineering group offering products and services with its three strong business areas (BA). The business area in which this research is carried out, is a global leading supplier of equipment, tools, service and technical solutions in heavy machinery industry. This business area consists of nine divisions of within one of them the empirical part of this research is conducted. The organizational structure of the case company can be seen in Figure 2.



**Figure 2.** Organizational structure of the case company.

Division 1 has production units (PU) in four different locations: Finland, France, Canada and China. The production unit of Finland being the focus of this research. The division is offering solutions to its customer with its eight distinctive product families, making their product offering very vast. The products provided by the company are highly customized to fit the demanding needs of their customers and often require engineering effort and close collaboration with the customer both prior and after the order has been received. Hence, it can be said that the manufacturing in the case organization follows ETO manufacturing strategy.

## 1.5 Structure of the Thesis

After this introduction, the thesis continues with the research methodology in Chapter 2. The aim of this part of the thesis is to present the research methods utilized as well as to describe the research process itself. In addition, the data utilized in this study is presented.

Theoretical background follows in Chapter 3. In this chapter, the structure and practices related to S&OP execution in MTS environment is studied. Based on the theoretical findings, an initial construction is created in the form of an execution framework for S&OP in MTS context.

Chapter 4 presents the results of the empirical part of the thesis in the form of understanding the requirements of ETO context to the execution of S&OP. The theory framework created in Chapter 3 was utilized to find similarities and differences between



the processes in MTS and ETO environments, which were then utilized in the building of the final construction.

The final construction, the execution framework for S&OP in ETO environment is presented in Chapter 5. In addition, the main findings of the research are summarized and discussed in relation to existing theory.

Finally, Chapter 6 concludes the thesis by answering to the research questions and evaluating the reliability and validity of the research. Ideas for future research are also proposed.

## 2. RESEARCH METHODOLOGY

This chapter presents the research methodologies used in this research. In addition, the research process is described in detail and the data gathering methods employed are presented.

### 2.1 Research Methodological Decisions

To be able to understand how the research was conducted, it is essential to present the methodological assumptions behind it. Saunders et al. (2009, p. 108) uses the research onion to present the different aspects of methodological assumptions that should be made visible in the research. These are philosophy, approach, strategy, methodological choice, time horizon and data collection techniques. The first two of these cover the so-called taken-for-granted assumptions while the rest explain the research design and the details of data collection carried out in the research. Summary of the methodological decisions made in this research are presented in Table 1.

*Table 1. Summary of the methodological decisions made.*

<b>Methodological decision</b>	
<b>Philosophy</b>	Interpretivism
<b>Approach</b>	Abductive
<b>Strategy</b>	Constructive
<b>Methodological choice</b>	Multi-method qualitative
<b>Time horizon</b>	Cross sectional
<b>Data collection techniques</b>	Semi-structured interviews, observation, literature and other secondary material

The research philosophy chosen for this research is interpretivism. By understanding the philosophy used, the researcher is able to identify taken-for-granted assumptions, examine and evaluate their appropriateness. In addition, it is argued that the chosen philosophy has a major impact on how the researcher understands what is being studied. (Saunders et al., 2009, p. 108) Interpretivism assumes that theoretical laws need the consideration of humans and their roles as social actors to support the justification of the world of business (Saunders et al., 2009, p. 109). Interpretivism is suited well to be used

in this study since the results of this study are based on subjective evaluation and opinions from different parts of the organization with support from existing theories. In addition, a small sample and qualitative data gathering methods are used, which supports the use of interpretivism in this research.

The research approach used in this research can be referred to as abductive. Abductive research is something between inductive (testing theories) and deductive (creating theories). Abductive research can be used to combine theory and practice in creating understanding of phenomenon under study (Pirkkalainen, 2019). Since in this research, the aim is to build a framework based on the key findings from literature and then modify it to suit ETO manufacturing environment, it is a clear example of an abductive research.

The choice of the research strategy should be based on the research question at hand (Saunders et al., 2009, p. 141). The research strategy used in this research is constructive research. Constructive approach to research is problem solving through the construction of models, diagrams, plans, organizations etc. (Kasanen et al., 1993). The characteristics that make constructive approach suitable for this research include:

- focuses on real-world problems that should be solved in practice
- produces an innovative construction meant to solve a managerial problem
- includes an implementation attempt of the construction and test of practical applicability
- implies close involvement and cooperation between the researcher and practitioners
- is linked to prior theoretical knowledge
- reflects the empirical findings back to theory (Lukka, 2000).

The constructive research approach typically follows the following pattern:

1. Identify a practical problem
2. Obtain comprehensive understanding of the research area
3. Innovate and construct a solution or idea
4. Demonstrate that the solution works
5. Show the theoretical connections and the research contribution of the proposed construction
6. Evaluate the applicability of the solution. (Kasanen et al., 1993)

According to Johnson & Kaplan (1987), Kaplan (1986) and Kasanen et al. (1993) innovation phase is in the core of a successful constructive research since that is the part where the researcher produces a new solution to the problem. One of the final parts

in the constructive research is the testing of the practical contribution. The validity testing should be done by the “market mechanisms” (Kekale, 2001). In this research, this is done using the weak market test, which means that if the construct is accepted as a feasible solution to the problem by the case company and is put to use, the construct is considered as valid (Kekale, 2001). In this research, all of the research phases listed above are recognized, hence the research can be considered as constructive.

Since constructive research approach is employed in this study, it supports the use of qualitative data gathering methods. Qualitative methods are typically used to increase understanding and answer questions like “why” and “how”. Notable is that in order to analyze qualitative data it needs to be restructures, categorized and summarized since qualitative data can be complex and in non-standardized form. (Saunders et al., 2009, p. 482).

Only qualitative data gathering methods are used in this research. The data gathering methods used during this research are semi-structured interviews, observation and use of existing secondary case company material. Since multiple different data gathering methods are used, the research can be considered as a multi-method quantitative research (Saunders et al., 2009, p. 152). Triangulation refers to the use of multiple different data collection techniques within one research in order to supplement one another (Saunders et al., 2009, p. 146). Hence, to develop a comprehensive understanding of the subject, multiple data gathering methods are used. The time horizon of the research design employed in this research is cross-sectional since the research provides a description of a certain phenomenon at a certain time (aka snapshot) (Saunders et al., 2009, p. 155).

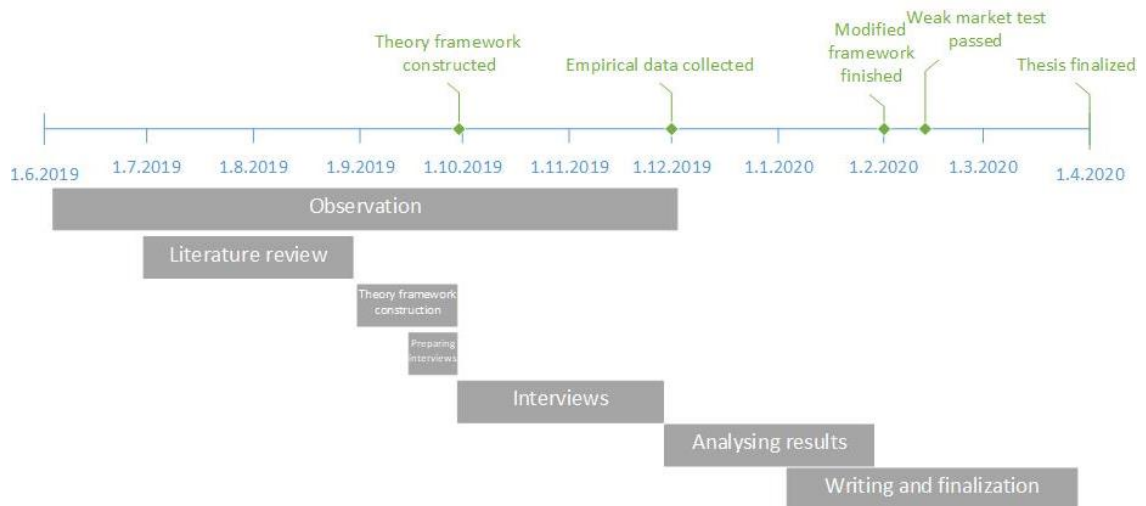
When it comes to the data collection techniques, this research is a combination of literature review and empirical study. The empirical part consists of primary data gathering methods of semi-structured interviews and observation and secondary data gathering method of use of existing material. Semi-structured interviews are usually referred to as qualitative research interviews. In these types of interviews, the interviewee has a list of questions to be covered but they can vary from one interview to another depending on the organizational context. In addition, additional questions may surface during the interview, in order to get relevant answers considering the research question and objectives at hand. (Saunders et al., 2009, p. 320) The use of semi-structured interviews in this research is essential in order to collect rich and detailed qualitative set of data to support in the modifying of the theory framework.

The form of observation used in this research is called participant observation and it provides qualitative data. The role of the researcher in the observation is called participant as observer, referring to the fact that the researcher's identity is revealed, and the researcher takes an active part in the activity under observation. Participant observation is typically good at explaining "what is going on" in particular social situations and processes (Saunders et al., 2009, pp. 294-299). The use of observation is justifiable in this research since it is essential to build a coherent picture of the setting, key participants, activities and other related events and their sequence in the sales and operations planning process in the case company as well as of the context they operate in. Through observation, the researcher might also be able to find out realities about the organization that the people working for the organization might not even be aware of and, hence, do not surface in the interviews. In addition, observation is considered a practical data collecting method when the researcher is working in the case company herself (Saunders et al., 2009, p. 299).

The sampling techniques used in this research to select people to participate in the interviews were purposive sampling and snowball sampling. The purposive sampling refers to an approach where the researcher him/herself selects the cases that will be most suitable in helping to find an answer to the research questions based on his/her own judgement (Saunders et al., 2009, p. 237). In this specific research, this means that the stakeholders who are directly involved in the S&OP process execution in the case company are interviewed. In addition, some of the interviewees suggested additional people who should be interviewed regarding the topic. Hence, also snowball sampling is used.

## **2.2 Research Process**

The research process followed the structure of a typical six-step constructive research process presented earlier by Kasanen et al. (1993). The timeline of the research process is illustrated in Figure 3.



**Figure 3.** Timeline of the research process.

### **Step 1 – Identify a practical problem**

A practical problem relevant for a constructive research process was introduced by the managers of the case company. Due to organizational changes in the case company the S&OP needed a development effort. The current S&OP did not support the decision-making in the extent wished for, which was the main reason behind launching the thesis project.

The research process itself started with a thorough literature review on the current academic discussion on the concept of S&OP. Soon, it was noticed that there existed a lack of research on S&OP in ETO context. This finding initiated the need to not just build a framework on the execution of S&OP based on existing knowledge but to modify it according to the context specific needs and characteristic of ETO environment. The research questions were formed by considering what milestones need to be fulfilled and what knowledge need to be gathered in order to reach the objective of the research.

### **Step 2 – Obtain comprehensive understanding of the research area**

The second step in the research process can be divided into two parts: participant observation and literature review. The pre-study phase was initiated in June 2019 when the researcher started working as a S&OP Trainee in the case company. She was involved in the S&OP process execution by preparing material and facilitating the process meetings. In addition, she attended weekly production and production planning meetings. The researcher had worked for the supply organization of the case company in previous years as well. Hence, it can be said that the researcher had a coherent picture of the operating environment of the company as well as on the S&OP process itself.

The literature review started in July 2019. Scientific literature such as articles, publications, books and e-books were searched using keywords like “sales and operations planning”, “S&OP”, “integrated business planning”, “demand and supply balancing” and “collaborative planning”. Some material was also found through references in read articles. By summarizing data, principal themes around the concept of S&OP could be identified. These main themes were then used as sub-headings in the literature review chapter of this research. Information grouping was then used to gather relevant information under these headings.

### **Step 3 – Innovate and construct a solution or idea**

The construction process itself can be divided into building the initial construction based on academic literature, building a coherent understanding of the requirements and practices employed in ETO context related to the execution of S&OP and modifying the initial framework based on these findings.

Based on the scientific material found, a framework addressing the execution of sales and operations planning in MTS environment was built. The classification used in the theoretical background was applied also in the building of the framework. The framework was built by studying articles around the topic of S&OP and identifying patterns on how the process structure looks like and what are the best practices related to the process. Questions like what resources, tools or other capabilities the process execution requires were aimed to be answered. Tabulation was used to collect and group the findings based on the main concepts around S&OP identified. The most frequently mentioned practices in the literature were used in the construction of the theory framework. In most of the articles and other publications discovered, S&OP was addressed in MTS environment and in industries like pharmaceutical, consumer goods and chemical. Hence, the theory framework constructed is only applicable to MTS environment.

Interviews together with observation were the main data collection methods in this study. The aim of the interviews and observation was to find out the requirements and practices employed related to S&OP in the case company in order to modify the theory framework to the needs of ETO environment. In other words, the initial construction was modified based on the analysis conducted on the interviews and observation carried out in the case company.

The theory framework constructed in the literature review part served as a base for the planning of the interview questions. To complement the other empirical data collection methods, secondary data, in the form of company brochures, presentations, consult material, code of conducts, annual reports and process guidelines, were also used.

The analysis on the empirical data consisted on analyzing the interview data and supplementing these findings with observation and studying of the secondary data. As a result of the analysis on the empirical material collected, a coherent picture of the structure and practices related to the execution of S&OP as well as on the requirements of ETO environment was gotten. After these findings had been documented, the process itself and the practices related to it were compared with the initial framework created for MTS environment. Differences and similarities were looked for and Venn diagram was created to summarize the findings. Based on the differences identified, the initial framework was modified to ETO environment specific needs. Thus, a final construction in the form of an execution framework for S&OP in ETO environment was created.

#### **Step 4 – Demonstrate that the solution works**

According to Kasanen et al. (1993), the implementation of the construction and the feedback received from that play a crucial part in demonstrating the usefulness of the solution. In this study, already during the construction of the final framework, smaller entities of the solution were implemented gradually, which enabled the testing of the solution in small entities. The feedback gotten after the implementation of the sub-constructs was used to make adjustments to the final solution. However, since the scope of this study was only on developing a construction to solve the problem presented by the case company, a thorough practical testing of the solution was not possible in the timeframe provided. Hence, this study does not provide concrete results of the effects of the solution on the performance of the company. However, some speculation of the possible effects is presented in the discussion part of this study.

#### **Step 5 & Step 6 – Show theoretical connections and research contribution & evaluate the applicability of the solution**

As the final steps in the construction research process the reliability and validity of the research were discussed. By doing this, it was evaluated if the researcher was able to make connections between the empirical findings and the existing theory, which supports the research contribution of the study. In addition, the transferability of the construction was examined with the help of a weak market test. The above-mentioned topics are documented in the discussion and conclusion chapters of the study.

### **2.3 Research Data Collection and Analysis**

Interviews, observation and the use of existing secondary data are the data collection methods used in this research. In addition, weak market test is used to validate the results of the research.



### 2.3.1 Interviews

The interviews were conducted between October and November 2019. All the interviewees were employed by the case company and had an essential role in the execution of the S&OP process. The aim was to interview representatives from all of the different functions taking part in the S&OP process, enabling getting comprehensive understanding of the process. The group of interviewees included both people in managerial and executive positions. The interviews were conducted face-to-face and altogether eight interviews were held.

List of themes and questions to be covered in the interviews was planned beforehand. The questions of the interviews were based on the theory framework constructed during the literature review. The overall outline of the interviews remained the same during all of the interviews, but some function specific questions were added to some of the interviews. Notes of the interviews were recorder. A summary of the interviews held is presented in Table 2.

**Table 2.** *Summary of the interviews*

<b>Interview</b>	<b>Function</b>	<b>Role</b>	<b>Duration (min)</b>
1.	Procurement	Procurement Manager	59
2.	Manufacturing	Manufacturing Manager	60
3.	NPD	NPD Manufacturing Manager	40
4.	Sales	Order Desk Manager	55
5.	Sales	Area Manager	30
6.	Operations	Supply Chain Director	40
7.	Finance	Finance Director	40
8.	Production Planning	Production Planner	30

Interview answers were collected to Excel where they were categorized according to the classification found in the theory framework constructed. Thus, key findings and problems were easier to recognize as well as possible repetition in answers between the interviews. The answers of the interviews were kept separate during the analysis to be able to retain the evidence if needed afterwards. Some direct quotes were also picked

from the interviews to enliven the reporting of the empirical results. Conclusion from the interview results were drawn based on the most common answers.

### **2.3.2 Observation**

Observation, executed as part of empirical data gathering in this research, took place between June and November 2019. Observation took place in the meetings held as part of the S&OP process in the case company as well as in informal discussions with the process stakeholders. Altogether six rounds of S&OP process (1 round/month) were observed. The aim of the observation was to gain understanding on how the S&OP process is being executed in the case company. In other words, to gain knowledge of the setting, key participants, activities and other related events and their sequence in the S&OP process in the case company as well as of the context they operate in. In addition, potential development areas within the process were identified. The observation enabled the researcher to understand the process better and gain tacit knowledge about the challenges and informal methods in the process execution that could have not been gained through interviews.

The researcher herself had an active role in two of the six observations rounds. Meaning that during those two rounds the researcher was responsible of the overall management of the S&OP process. Hence, she facilitated the process meetings. During the other rounds of observation, the researcher was not responsible of the overall management of the process, but she prepared material for the meetings and carried out other support activities related to the process execution.

The researcher herself has an active role in in the process execution in the case company. Hence, the personal experiences gained as a result of this, enables gaining a deeper insight into the process itself. However, at the same time it poses some questions about the objectivity and generality of the study. Detailed description of the execution of the research as well as careful analysis of the empirical data collected, enables the mitigation of the subjectivity.

### **2.3.3 Secondary Data**

In order to gain comprehensive understanding of the case company's operations and current S&OP process, internal company material was studied. The studied material can be divided into general company information material and S&OP process specific material.

The general company information material included company brochures, company presentations, code of conducts, annual reports and company process guidelines. This material was distributed in the case company's intranet. The S&OP process specific material included old S&OP presentations, S&OP calendar, consult material related to S&OP and process charts and descriptions. This material was distributed via email, in SharePoint and in the company's Integrated Management System (IMS).

### **2.3.4 Weak Market Test**

As one of the final steps in the constructive research process comes the evaluation of the applicability of the solution (Kasanen et al., 1993). In addition to evaluating the applicability of the solution in the case company, the transferability of the construct should also be assessed (Lukka, 2000). According to Kasanen et al. (1993), a managerial construct can be validated by conducting a market test, which is based on innovation diffusion.

A Market test can be considered weak, semi-strong or strong depending on the extent to which the construct has been adopted. A weak market test is fulfilled when a manager of the organization is willing to apply the solution to actual case company problem. Semi-strong market test is passed if the construct has been widely adopted in multiple companies while passing the strong market tests implies that the business units that have decided to apply the solution are systematically producing better financial results than those not applying the solution. According to Labro & Tuomela (2003), when it comes to a constructive case study it is not possible to go beyond the weak market test since the main issue is on whether the case company has or has not adopted the construct. However, Lukka (2000) argues that the weak market test should focus more on the actual implementation of the construct rather than in the willingness to do so.

In this research, a weak market test was carried out to test the applicability of the construction. The execution and results of the weak market test are elaborated on in the discussion chapter of the thesis.

## **3. SALES AND OPERATIONS PLANNING**

The aim of this chapter is to introduce the concept of sales and operations planning and form a coherent picture of the academic literature around it in MTS environment. The chapter starts by defining the concept of S&OP and reviewing the terminology around it. After this the process of S&OP is explained first on high level and then more detailed description of each process step is given. After the process description, the key focus areas planning parameters, organization and enablers of S&OP are introduced. Finally, based on the theory, execution framework for S&OP in MTS environment is constructed, which is later in this thesis modified according to the environment specific needs of ETO environment discovered from the empirical part of this research.

### **3.1 Definition and Terminology**

S&OP is seen as a tool for coordinating many critical activities within a company (Vollmann & Whybark, 1997, p. 270), which are employed to match supply with demand in medium term (Stank et al. 2011). The other way to put it, is to say that S&OP balances demand and supply (Bower, 2005; Wallace, 2006; Boyer, 2009) or that demand is synchronized with supply capabilities (Cecere, 2006). Besides the traditional view of balancing demand and supply, S&OP process is also seen to align production volumes and product mix and integrate operational and financial plans for master scheduling (Wallace, 2006). Nowadays, S&OP is more and more seen also as a way to create organizational alignment with the operating strategy and as a result improve revenue, decrease inventory levels and reduce costs (Cecere, 2006). The possibility for S&OP to affect firm's performance has clearly been noticed.

According to Cecere (2006) the traditional approach to matching demand with supply is outdated and nowadays S&OP is moving towards a more demand driven process. This means that more emphasis is given on the demand planning phase of the process. In addition, many authors highlight the importance of taking into account the strategic agenda of the company when deciding on the actions needed to balance the demand and supply (Vollmann & Whybark, 1997, p. 270; Cecere, 2006; Tuomikangas & Kaipia, 2014). In other words, the plans created as an outcome of the S&OP process should take into account all the constraints of supply while at the same time following the strategic agenda of the company.

Some authors also refer to S&OP as a decision-making process (Wallace, 2006; Boyer, 2009; Stank et al., 2011; Feng et al., 2013). The process is at its best when both tactical and strategic decision can be made (Stank et al., 2011) and it is obvious that decisions like these cannot be made without information and knowledge sharing that happens during the S&OP process. The process represents a forum where representatives from different functions share their knowledge and together discuss how to use this information to run the business (Stank et al., 2011). Feng et al. (2013) agrees on the previous statement by saying that S&OP requires intense cross-functional collaboration and ability to integrate decisions over the whole organization and its supply chain network. The ultimate aim being at establishing common objectives for each of the major functions based on a holistic view and the best trade-offs between demand, supply and finance (Vollmann & Whybark, 1997, p. 270).

Because of the need for high level of cooperation within different functions, S&OP has an important role in the supply chain management. It integrates the different organizational units and functions within a company as well as increases coordination and collaboration between them (Tuomikangas & Kaipia, 2014). In addition to aligning different organizational units together, S&OP also brings the company's executives closer to the tactical planning. Boyer (2009) describes it as top management's handle on business while Wallace (2006) states that the process helps managers to get a holistic view of the status of the business and give insight of the future as well.

In addition to collaborative effort, in order to S&OP to make a difference in the company's performance, a huge amount of data, solid business knowledge, time and dedication from all the process players (Boyer, 2009) and ongoing analysis of available intelligence and key metrics (Bower, 2005) are needed.

To sum it up, S&OP serves as communication and decision-making platform that addresses decisions on the production volume, product mix and the company's key resources. All this is done considering the constraints of supply and the overall strategy and business objectives of the company.

The terminology around S&OP can be seen somewhat confusing. According to Iyengar & Gupta (2013), sales and operations planning (S&OP) was the original term used in 1970s when the concept was introduced for the first time. Nowadays Executive S&OP (Iyengar & Gupta, 2013) and Integrated Business Planning (IBP) (Iyengar & Gupta, 2013; Wilson & Raman, 2017) are also used to refer to S&OP.

Some authors use the term IBP when financial planning is combined with demand and supply planning (Prokopets, 2012), referring to the history when S&OP was just about

demand and supply balancing without that big of a focus on finance or the overall business strategy. Nemati et al. (2017) uses the term Fully Integrated S&OP (FI-S&OP) in the same context wanting to emphasize that all the functions have been integrated to the process.

In this thesis, S&OP is referred to as process that in addition to demand and supply planning also considers financial and business targets together with strategic objectives of the company.

### **3.2 Sales and Operations Planning Process**

S&OP process is not a separate from the company's other key processes and, hence, it also should not be managed as one. There have been identified many other processes that the S&OP uses as an input or processes that in turn use the output of S&OP as their input. In order to maximize the performance of all of the processes, the inter-linkages between the company's processes should be studied and managed. (Iyengar & Gupta, 2013) It has been noticed that S&OP processes can vary according to the industry and manufacturing strategies (Thomé et al., 2012).

The process of S&OP consists of planning activities, decision-making process and cross-functional collaborative activities (Tuomikangas & Kaipia, 2014). The most successful companies have very formalized process with clearly defined steps, milestones and reviews that are conducted in set intervals (Prokopets, 2012; Thomé et al., 2012). According to Grimson & Pyke (2007), the most advanced S&OP processes are optimized for demand and supply to maximize profitability instead of just sales revenue or operational efficiency.

The ultimate goal of the process according to Thomé et al. (2012), is to achieve balance between demand and supply as well as improvement in both vertical and horizontal alignment in the company. In addition, plan integration is sought after. Tuomikangas & Kaipia (2014) also highlight the cross-functional collaborative nature of the process stating that the essence of the process is the collaborative planning and decision-making between functions. Besides these, also more operative goals have been identified. These include improvements in forecasts, inventory, management of product mix and volume and use of capacity resources (Thomé et al., 2012). End-result focused goals of S&OP process include enhanced customer service and performance of supply chain as well as increased revenue and minimization of demand distortion (Thomé et al., 2012).

According to Thomé et al. (2012), most commonly the S&OP process uses inputs like demand, sales and production plans. Plans for supply, procurement, finance and

distribution can also be used but they are seen less important. Prokopets (2012) only considers demand plan as the input to the process. When it comes to the output of the process, Prokopets (2012) states that supply plan defining the manufacturing and supply activities required to meet the demand and highlighting the constraints is the major output of the process. Both Thomé et al. (2012) and Prokopets (2012) argue that the most important constraint that should be evaluated is the production capacity. In addition, constraints on pricing, competitive actions, inventory and supply chain should be considered (Grimson & Pyke, 2007). Thomé et al. (2012) continue that financial restrictions are also studied but they are usually viewed more as goals than restrictions.

The following steps of the S&OP process have been identified from the literature: data gathering, product management review, demand review, supply review, pre-executive meeting, executive meeting, measuring the results and effectiveness of the process and communicating the output. Notable is that, all of these steps are not present in all S&OP processes studied and the steps can be referred to a bit differently in different companies. The process steps are illustrated in Figure 4.



**Figure 4.** S&OP process steps identified from literature.

All the process steps will be elaborated further in the following sub-chapters. Goals, inputs and outputs as well as key roles for the process steps will be covered.

### 3.2.1 Data Gathering

Data gathering is counted as the first step of S&OP process according to Wallace (2004) and Cecere et al. (2009). Most of the authors do not consider data gathering as a separate step in the process but they include the tasks related to it in the other steps of the process. In other words, even though data gathering is not seen as an own step by all of the authors, it is still considered an essential activity in the S&OP process.

Between Wallace (2004) and Cecere et al. (2009) there is a difference on how they see the roles within data gathering. According to Wallace (2004) IT systems department is responsible of the process step while Cecere et al. (2009) say that S&OP representative should be the responsible. However, when it comes to defining the goal of the process the authors are on the same page. The goal is to gather data from sales and marketing, production and inventories as well either develop a statistically generated forecast or collect sales forecast manually. According to Boyer (2009), the sales forecast input

should tell what the sales are going to sell within a certain timeframe. Boyer (2009) also states that all the data should be reported as month-end actuals. All the collected data serves the as input to the next process steps.

Wallace (2004) divides data gathering into three steps. These are updating the files with month-end actuals after the month has ended, generating information for sales to be used in the development of new forecast (i.e. sales analysis data and statistical forecast reports) and disseminating this information to the appropriate people.

### **3.2.2 Product Management Review**

Product management review or portfolio management review is acknowledged as one step of S&OP process by Schorr (2007c) and Bower (2005). Brand/product strategy, stage gate plan, status of each new product, rough resource and capacity requirements and marketing initiatives serve as an input to the process. The objective of the meeting is to describe and detail the future direction of the product portfolio of the new models as well as agree on product improvements, repositioning of current products and end-of-life rationalization of older products. Product management review is considered important since the company must plan new products to replace older products and thereby fuel business growth. (Schorr, 2007c)

As a result or output of the meeting, new product family plans are created together with assumptions and risks related to these. Changes are also documented, and resources managed. (Schorr, 2007c) The S&OP dashboard is also updated according to the new plans. The owner of Product management review is the head of product development and the meeting should be facilitated by a new product development coordinator. In addition, Product Managers and representatives from R&D are expected to attend the meeting. (Schorr, 2007c)

Notable is that the product management review was considered as part of the S&OP process only by two authors. This can indicate that the process step is not commonly seen as an essential part of the process and that the topics covered in the product management review belong to some other key process of the company. However, both Schorr (2007c) and Bower (2005) emphasizes the importance of having this process step as part of S&OP since it is vital to keep an eye on the products going through lifecycle stages to be able to manage this with the least amount of cost to the organization as well as keep management up to date on the changes happening.



### 3.2.3 Demand Review

Demand review is acknowledged as one of the first steps of the S&OP process by many authors (Wallace, 2004; Bower, 2005; Grimson & Pyke, 2007; Schorr, 2007a; Boyer, 2009; Cecere et al., 2009). This refers to the fact that reviewing the demand situation surely is in the core of the whole S&OP process.

Cecere et al. (2009) and Boyer (2009) consider the sales forecast as the only input to the demand review but Schorr (2007a) also adds business strategy, customer plans, market intelligence, statistical projections as well as new model plans from the previous step to the list of inputs. Hence, it can be said that sales forecast is the most valuable input.

When discussing about the output of the demand review, the authors are using different words to describe it, but they are referring to the same basic idea. The output of the process step is a demand plan, which serves as a demand consensus. Demand plan is supposed to be unconstrained and be based on consensus and collaboration (Wallace, 2004; Schorr, 2007a; Boyer, 2009; Cecere et al., 2009). Again, Schorr (2007a) is describing the outputs in more detail adding summary of the reasons for changes and document of assumptions, vulnerabilities and opportunities to the plan to the list of outputs.

When it comes to the goal of demand review, the authors agree strongly. The ultimate goal of the process is to develop an unconstrained demand plan that shows what the company is realistically supposed to sell within a set timeframe. The demand plan should be created in collaboration and should be consensus based. (Bower, 2005; Grimson & Pyke, 2007; Schorr, 2007a) In addition, Boyer (2009) describes the agenda of demand review as reviewing past months performance, discussing the reasons behind off-plan performance, coming up with corrective actions and reviewing the sales forecast. To reach the goal of demand review, some metrics are used to help in the evaluation of sales forecast and turning it into a demand plan. These metrics are demand plan accuracy, sales plan accuracy, demand plan bias and market share (Schorr, 2007a).

People who are involved with demand review include sales, marketing, product management, new product coordinator, supply manager and demand manager (Schorr, 2007a). In addition to these, Wallace (2004) also includes finance to the demand review meeting. It can be argued that if the company conducts both the product management review and demand review product management and new product coordinator might not be needed in demand review since the new model plans have already been reviewed. The person who is accountable or owns the demand review process step is the head of

sales and marketing and the meeting is facilitated by a demand manager (Schorr, 2007a).

### **3.2.4 Supply Review**

After the demand review the next step in the process is the supply review. As was the demand review considered as a vital part of the process, so is the supply review. However, Boyer (2009) skips supply review -step entirely but discusses the same issues in the next step (pre-executive meeting) of the process. The things that Boyer (2009) considers regarding supply during the S&OP process are the identification of any supply issues that restrict the execution of sales plan and evaluating if the inventory and backlog targets are met. After this, shipment and supply plans are finalized. Hence, it can be said that the reviewing of supply can be considered as a separate step but can also be merged into wider review together with other functions of the organization in the pre-executive meeting.

As could be expected, many authors consider the output of the previous step (demand review) as an input of supply review (Grimson & Pyke, 2007; Schorr, 2007d; Cecere et al., 2009). However, Grimson and Pyke (2007) and Schorr (2007d) state that the demand plan should not be the only input since it should be evaluated together with more strategical inputs like business, manufacturing and inventory strategy.

According to Schorr (2007d), the supply should always aim at saying “yes” to the demand plan. If the demand exceeds the capacity or resources of supply, they are supposed to develop different alternatives to enclose this demand-supply gap. Typically, the solutions could include alternatives like building new facilities, purchasing new machinery/equipment or acquiring new third-party manufacturers. During the supply review the different alternatives are evaluated regarding costs and other issues and compared with the overall business plan of the company.

As an output of the process should come a supply plan (Grimson & Pyke, 2007). This is a rough-cut capacity plan that is supposed to meet the requirements of demand plan including also constraints, demand shortfalls and capacity opportunities (Cecere et al., 2009) as well as any other supply problems (Wallace, 2004). The ultimate goal of demand review is described well by Cecere et al. (2009) as to develop a constrained plan by supply while building flexibility and agility into supply to minimize the errors in forecasting. Bower (2005) describes the meaning of supply review as reviewing of supply plans to align business strategy with business reality. Metrics that are used during supply

review to help reaching the targets of the meeting are ROA, profitability, revenue, customer service and working capital (Cecere et al., 2009).

According to Schorr (2007d), the participants of the supply review can be divided into four distinctive groups. These are manufacturing and production, purchasing, logistics and distributions and engineering and design. The accountability of this step belongs to head of manufacturing/supply chain/operations and the facilitator is the supply manager. Wallace (2004) also considers finance and S&OP process owner as part of this process step.

### **3.2.5 Pre-executive Meeting**

While Boyer (2009) skips the supply review -step and moves directly from demand review to pre-executive step, Grimson & Pyke (2007) and Cecere et al. (2009) skip the pre-executive meeting. Both Grimson & Pyke (2007) and Cecere et al. (2009) do conduct the supply review, hence it can be said that it is totally up to the company running the S&OP process to decide how many steps do they want to have in the process. However, it is worth noticing that no matter how many steps are included in the process, more or less the same activities are carried out at some point of the process.

Pre-executive meeting or pre-S&OP meeting (Boyer, 2009) or Integrated reconciliation meeting (Schorr, 2007b) aims at developing recommendations to be presented in the executive meeting. The recommendations cover the issues that stem from aligning the demand and supply plans. Multiple different scenarios can be reviewed and evaluated during this process step to show alternative courses of action to solve a problem arising from the plan alignment. The scenarios are evaluated from the financial and strategic point of view as all the plans should be aligned with to the company's strategic and business plan. (Wallace, 2004; Schorr, 2007b) Bower (2005) emphasizes the fact that the pre-executive meeting is a reconciliation step, meaning that with a help of different metrics, the performance of the firm is evaluated and if there is a gap identified between the result and expectations, ideas and scenarios are formed to enclose these gaps and solve any constraints that may have been identified. Notable is also that the proposed changes are also given a monetary evaluation (Bower, 2005), which emphasizes finance role in this process step. Schorr (2007b) also adds that if the company has any other issues or projects that do not fit in the evaluation done during the previous steps in the process, they fall to the agenda of the pre-executive meeting.

Notable is that this is the first step in the S&OP process where finance and business strategy have an active role in commenting and evaluating the plans from their point of

view. According to Boyer (2009), in addition to evaluating materials, capacity and supplier capabilities, previous month's performance should be reviewed. Wallace (2004) also adds that one of the goals of pre-executive meeting is to set an agenda for the executive meeting.

Since the aim of the pre-executive meeting is to build a coherent picture of the current decision-making situation and prepare broadly evaluated and discussed recommendations to the executive team, it is evident that the inputs of this process step include all the issues raised during the previous steps of the process, changes to the plans from previous month and alternative proposals made during the earlier steps in the process (Schorr, 2007b).

Schorr (2007b) describes the output of the pre-executive meeting as the updated S&OP packet. The packet includes all the essential information required for decision-making including gaps to the business and strategic plan, preferably in visual form, as well as recommendations for the future. Wallace (2004) does not refer to S&OP packet but he covers most of the same things as Schorr (2007b) when listing the outputs of the pre-executive meeting. These include recommendations and future course of actions for each product group, changes to resources or demand/supply strategies, updated financial view of the business and agenda for the next meeting. Wallace (2004) also lists some metrics that should be viewed during the meeting, which help in reaching the consensus on the recommendations. These include the performance to plan sales and the status of production, inventory and backlog.

Since the pre-executive meeting is a reconciliation meeting, it is evident that it involves participation by many different functions. Integrated view from at least demand, supply and finance is expected (Schorr, 2007b).

### **3.2.6 Executive Meeting**

As a subsequent step after the pre-executive step, comes the executive meeting (Wallace, 2004; Bower, 2005; Grimson & Pyke, 2007; Schorr, 2007f; Boyer, 2009; Cecere et al., 2009). Executive meeting can also be referred as a senior management review (Bower, 2005).

The agenda of the executive meeting is to present the previous month's performance with the help of selected metrics to the executive team together with demand and supply plans and examine any significant issues related to these. After this the senior management discusses the alternative scenarios and then makes a decision on the plan

for the future. (Bower, 2005; Boyer, 2009) The decisions are documented, and meeting minutes are recorder as well (Wallace, 2004).

According to Cecere et al. (2009), the ultimate goal of the meeting is to reach a consensus after a thorough review and discussion. In addition to reviewing past month's performance, discussing new product issues, special projects or other issues and making a consensus-based decision on the future actions, Wallace (2004) points that one goal of the meeting is also to authorize changes in for example production or procurement rates, which are needed to reach the target of the new agreed plan. Comparison between the proposed plan and the business plan is also done (Wallace, 2004). The metrics that can be reviewed during the meeting to help in reaching the goals, should cover critical operational, financial and strategic measures and summaries of the business/supply/demand/inventory plans by product family.

The owner of the executive meeting is the president and all of his/her direct reports should attend the meeting, meaning the executive management team as a whole (Schorr, 2007f; Boyer, 2009). There should be a representative from demand, finance and operations as well as the S&OP process owner present in the meeting. (Schorr, 2007f) The role of the senior management is to offer direction, make decision and give prioritization and information to help to resolve any issues or gaps identified (Bower, 2005).

The recommendations and alternative scenarios that are formed as a result of the pre-executive meeting, serve as an input to the executive meeting (Schorr, 2007f). At the simplest, the executive meeting just accepts the recommendations made in the pre-executive meeting (Wallace, 2004). As an output, an approved plan is formed, which covers plan for sales, order backlog, shipments, inventory and supply (Wallace, 2004; Boyer, 2009) as well as any modifications made to the business plan (Wallace, 2004). Hence, all the planning and execution that happens in the company should derive from these plans (Boyer, 2009).

In other words, the executive meeting is a process step for which all the previous steps in the process are preparing data, information or other kind of input, in order to facilitate and support the executive team in the decision-making.

### **3.2.7 Measuring the Results and Effectiveness & Communicating the Output**

According to Grimson & Pyke (2007) and Cecere et al. (2009) measuring the result and effectiveness of the S&OP is also an essential part of the process. The metrics that

should be used vary depending on the industry, process and product line of the company (Grimson & Pyke, 2007). Some examples of these include cash flow, forecast accuracy, inventory development and customer service (Cecere et al., 2009).

Both Boyer (2009) and Cecere et al. (2009) consider communicating the S&OP output as the final step in the S&OP process. It is slightly surprising that the other authors do not mention this step in their S&OP process description since it is widely acknowledged that S&OP requires cross-functional collaboration and, hence, also the communication between the functions should be seamless. However, Schorr (2007f) mentions that as part of the executive meeting -step, the meeting minutes should be communicated to the process stakeholders as well as broader audience since the decisions made in the executive meeting will have an impact on various departments in the organization.

### **3.3 Planning Parametres**

As mentioned earlier, S&OP is situated in the planning hierarchy between strategic and tactical planning, linking these two together. If strategic planning is done on a yearly level and tactical planning on a weekly/daily level, that means that S&OP should be carried out monthly. According to Iyengar & Gupta (2013) many organizations are focusing too much on the short-term operations planning and too little on the long term. This can be due to the fact that the highly volatile and fast changing business environment of today is forcing organizations to be ready to react fast and therefore shift emphasis to short term planning. That is why it is important to create a clear distinction between long term strategical and short-term operational planning and differentiate the time windows required for the different layers in the planning hierarchy.

In the literature, there is a quite common view on what should be the planning horizon for S&OP. Grimson & Pyke (2007) state that the typical range for planning horizon is between 6-36 months but the most used seems to be 6-18 months. Prokopets (2012) and Gianesi (1998) agree that S&OP should consider at least over the time horizon of 18 months to create a balanced plan to meet the business objectives. However, also longer time horizons have been identified (Wallace, 2006).

Grimson & Pyke (2007) emphasize the fact that the horizons vary depending on the industry, product, seasonality as well as on the time of the year that S&OP occurs. Long planning horizons are common in industries with long lead times or high seasonality while shorter planning horizons are more common in industries with short lead times and low seasonality.

Wallace (2006) builds S&OP on four fundamentals, which are demand, supply, volume and mix. Balancing of demand and supply we discussed already before, but volume and mix will be elaborated here more closely. Volume refers to the big picture. It defines the ultimate need for product families, major resources, finished goods inventory and order backlog. The focus is on the aggregate level, considering also the strategy, policies and risks. When it comes to mix, the question shifts from “how much?” to “which ones, when and in what sequence?”. The focus of mix planning is tactical. Usually S&OP volume and mix planning is done on the product family level (Thomé, 2012). However, some cases show that SKU-based S&OP (Collin & Lorenzin, 2006) as well as combination of these two is also possible (Bower, 2005).

When it comes to the meeting frequency of the S&OP process, it varies across companies (Grimson & Pyke, 2007). However, it was clear that the meetings should be held in regular basis and the meeting calendar should be agreed on long beforehand (Grimson & Pyke, 2007; Prokopets, 2012; Thomé et al., 2012) Monthly cadence was found common (Prokopets, 2012).

### **3.4 Sales and Operations Planning Organization**

In order to have a successful S&OP, organizational effectiveness is one of the key ingredients. It enables ongoing governance and continuous improvement of the process (Prokopets, 2012). In this chapter, S&OP organization is divided into three aspects: strategic alignment, cross-functionality and roles and responsibilities.

#### **3.4.1 Strategic Alignment**

It is clear, that one major part of supply chain management is developing a supply chain strategy. The strategy helps companies to overcome barriers to supply chain performance, hence without a long-term strategic focus, the activities carried out in the supply chain will be misdirected and ineffective (Stank et al. 2011). Since S&OP is one of the planning activities within company’s supply chain, every decision made during the S&OP process should be tied with company’s strategic objectives (Singh, 2010) and S&OP should be only deployed after business and strategic plans are set (Thomé et al. 2012).

According to Cecere (2009), aligning goals and strategies within the company does not happen on its own, but it needs to be orchestrated. Without aligned goals and not having a clear strategy it is hard to make conscious decisions. Both Cecere (2009) and Tuomikangas & Kaipia (2014) see S&OP’s task as to be a vertical link between

company's strategic targets and operational planning. This refers to a two-way communication. Not only are the strategic goals being transferred into operational plans, but S&OP process also provides valuable feedback to the strategy planning process, helping the executives assess the success of the strategy and evaluate if corrective actions are needed.

In addition to linking company's strategic targets to operational planning, S&OP process can reinforce reaching of company's targets. Commonly, S&OP is used to drive productivity improvements but by identifying gaps between strategic business targets and S&OP plan, new products, markets and business models can also be discovered (Tuomikangas & Kaipia, 2014).

For S&OP to be able to have the strategic focus that it requires, the process needs to be driven from top-down (Grimson & Pyke, 2007; Singh, 2010). This means that the financial and business implications must be made clear and the financial metrics set by senior management of the company should be evaluated during the S&OP process.

To sum it up, it is essential, that like any process in the company, also S&OP should have its goals aligned with the overall business objectives and strategy of the company. In that way the strategy will be transferred into operational plans, which will then help the company to reach its targets. For all of this to work out, the process and goal need to be clearly set in the company.

### **3.4.2 Cross-functionality**

S&OP used to have a very intra-company perspective on the decision-making, but now the scope has gradually been extended to the whole supply chain (Thomé et al., 2012). This is one of the reasons why many authors emphasize the importance of formal structure in S&OP.

According to the coordination framework created by Tuomikangas & Kaipia (2014), it is essential to clearly define the S&OP organization. This means stating all the relevant organizations, units of organizations or other actors in the process as well as describing the formal structure of the S&OP organization including decision-making authorities and other key roles and responsibilities. The process requires a lot of pre-planning and follow-up activities, which emphasizes the importance of having a proper staffing for the process (Singh, 2010). Singh (2010) also agrees that S&OP process should have formally defined place in the organization, and it should be accepted as a function, just like any other function in the company.



In the literature, it is widely agreed that S&OP needs to be championed by a cross-functional team (Grimson & Pyke, 2007; Cecere et al., 2009; Singh, 2010; Thomé et al., 2012; Prokopets, 2012; Feng et al., 2013; Tuomikangas & Kaipia, 2014). The team should include representatives from sales, marketing, operations, supply, procurement, finance and R&D (Thomé et al., 2012). It is clear, that to become a top performer regarding S&OP, the company has to be able to link business execution activities across functions, to enhance the alignment with the company's business plan (Prokopets, 2012). In addition to integrating functions within the organization, Thomé et al. (2012) suggest that S&OP should also align with suppliers and customers.

In practice, the collaboration efforts within S&OP process have not always been successful. Grimson and Pyke (2007) have noticed difficulties especially in the integration of financial plans into S&OP practice even though, according to Wallace (2006), one of the main goals of S&OP is to integrate operational and financial planning.

It is not surprising that the integration of different functions and units within a company is difficult in practice. It has been noticed that it is usually even easier for functional units to collaborate with external parties than within the company itself (Sabath & Whipple, 2004). In addition, according to Bowesox et al. (2000) it is easier for functional units to collaborate within the function than across functions. Bowesox (2000) analyses that this is mainly due to the fact that the company's reward systems are more often optimized within a function rather than encouraging to cross-functional collaboration. Another factor that hinders the collaboration across functions, is the fact that the activities related to S&OP are secondary job for many of the participants, which affects negatively to the quality of their input to the process (Singh, 2010).

Prokopets (2012) lists a number of key building blocks that enable the integration initiatives across functions in organizations. These are integrated process for enabling the creation of aligned plans, aligned planning calendar, horizon and assumptions, standardized and aligned metrics and targets, use of cross-functional data and a culture that encourages to cross-functional collaboration. According to Thomé et al. (2012) cross-functionality is sought through meetings with representatives from all required functions and by having established good communication channels between the functions. Cecere et al. (2009) add to this list the importance of having a clear common goal, involvement of senior management and visibility in the process, meaning that the outcome of the process needs to be communicated to all the relevant stakeholders right after the final meeting of the process.

It can be said that S&OP truly is a cross-functional process and requires participation from different functions in the organization. The most relevant ones being sales, marketing, operations, supply, procurement, finance and R&D. In order for the cross-functionality to work, it requires formally defined process with clear roles and responsibilities. Formal structure and authority are the keys in the functional integration. The task of S&OP organization is to ensure that the process is managed as a continuous process instead of an episodic decision-making tool (Singh, 2010).

### **3.4.3 Roles and Responsibilities**

It has been widely recognized that people participating in the S&OP process, referred to as S&OP team, must be cross-functional (Grimson & Pyke, 2007; Cecere et al., 2009; Singh, 2010; Thomé et al., 2012; Prokopets, 2012; Feng et al., 2013; Tuomikangas & Kaipia, 2014). According to Singh (2010) and Piechule (2008), the success of S&OP process depends significantly on the empowerment of the S&OP team and the individuals participating in the team. Hence, it can be said that clear definition of roles and responsibilities within the team is a prerequisite to the success of the process.

According to Singh (2010), S&OP process should have a named leader who reports directly to an executive role. However, Iyengar & Gupta (2013) argue that the governance of S&OP process in organizations is not often clear. This means that nobody really knows who owns the process. If this is the case, there is a risk that the process lacks the overall coordinator who is supposed to bring the different functions together, define and enforce the rules, expectations and deliverables and monitor the performance of the process. In addition to these previously mentioned tasks, effective ownership includes goal setting and communication, measuring the team performance, participating in the process in an active way, facilitating data-driven decision-making and owning and adhering to the plans developed through the S&OP process (Prokopets, 2012). Bower (2005) also highlights that the S&OP leader should be a process facilitator and manager not a practitioner.

Schorr (2007b) argues that the process needs a S&OP coordinator to manage the overall process as well as the data. The main tasks of the coordinator are orchestrating the discussions and coordinating the development of agenda to the final meeting (Schorr, 2007b). In other words, making sure that the process is integrated and running seamlessly.

In addition to the S&OP leader/coordinator, in the S&OP team there should be participation by sales, marketing, demand planning, supply planning, finance and

procurement functions (Grimson & Pyke, 2007; Boyer, 2009; Prokopets, 2012). Boyer (2009) also adds that there should be a person from IT as a permanent part of the S&OP team. In addition, it is widely acknowledged that the process should have strong senior executive support and sponsorship (Grimson & Pyke, 2007; Boyer, 2009; Cecere et al., 2009; Prokopets, 2012).

Sales, marketing and demand planning as part of the S&OP team should be responsible of demand management and forecasting (Grimson & Pyke, 2007). This role includes providing data and information in fit-for-use form to be used in the S&OP process. This in turn requires solid understanding and knowledge of order entry and sales organization as a whole in terms of sales area managers, distributors, sales channels and customer base. (Boyer, 2009) In some companies, there is a separate role created to carry out these tasks since especially in bigger companies it can be a fulltime job to perform demand planning and forecasting and it could be too much work to be added to someone's current duties. Even though demand planning is primarily the task of sales, Cecere et al. (2009) highlight that it is a misbelief that sales knows what the company is going to sell, since they are heavily affected by bonuses. Sales forecast usually has a large bias and error, which should be taken into account when the forecast is being analyzed further. In addition, Singh (2010) argues that there can never be real discipline in the demand planning unless those responsible of it are made accountable for the costs that the forecast produces in the supply plan.

Supply planning or representative from operations should be knowledgeable about purchasing, inventory management, supply chain operations and master production scheduling (Grimson & Pyke, 2007; Boyer, 2009) as well as new product development (NPD) processes (Boyer, 2009). Hence, they are responsible of evaluating and communicating the supply related constraints for the S&OP process.

Like already mentioned earlier, in addition to the most obvious parties of the S&OP team, finance, IT and senior executives also play a role in the process. Finance's responsibility in the S&OP process is to make sure that the interfaces to finance and accounting are correct and credible (Boyer, 2009). Notable is that the budget should be an input to the building of the plan, but it should not constrain it (Cecere et al., 2009). Because of the very data heavy nature of S&OP process, Boyer (2009) emphasizes the importance of having a person from IT as part of the S&OP team. The process requires a large amount of data mining, system knowledge, reporting capability and data element engineering. Senior executives' role is to participate in the formal meetings where the planning work is reviewed and approved as well as to grant authority to implement the activities related to the plan decision (Grimson & Pyke, 2007).

In some companies, there are trainings organized for the key positions in the S&OP process as well as clearly defined skill sets for these roles to get the full benefits of the process (Grimson & Pyke, 2007). The most important thing when it comes to roles and responsibilities in the S&OP process is to emphasize the fact that when people “show up” and do the preparation they are supposed to this will be key to success (Boyer, 2009).

### **3.5 Enablers of Sales and Operations Planning**

In this sub-chapter, the enablers of S&OP are discussed. The enablers of S&OP are features or characteristics that somehow facilitate or improve the performance of the execution of S&OP in organizations. The enablers of S&OP are divided into three parts: tools and data, performance management and KPI's and S&OP culture and leadership.

#### **3.5.1 Tools and Data**

Since S&OP is a decision-making process (Wallace, 2006; Boyer, 2009; Stank et al., 2011; Feng et al., 2013), it requires data, information and knowledge based on which the decisions can be made (Boyer, 2009). This in turn requires different tools and systems that are able to collect, store, analyze and present data in desired form. Ongoing analysis of available intelligence and key metrics is required (Bower, 2005) and when the analytics are used in appropriate way it can help the S&OP process to become more meaningful and effective (Iyengar & Gupta, 2013). In the optimal situation, tools and data can tell the executives where they are, what results can be seen from their past decisions and what actions should be done next. Use of technology enables collaboration and supports different role requirements during the execution of S&OP process (Cecere et al., 2009). However, Grimson & Pyke (2007) emphasize the fact that technology and software may be required to support the process but more important is first to have a well understood S&OP process than superior data analytics tools. The effort, especially in the beginning of the implementation of the process, should be focused on setting up the process and empowerment of the team (Thomé et al., 2012).

Companies that are very advanced in data analytics have real-time and automatic solutions that enable the integration of different plans together (demand, supply and finance) as well as provide insight to supply chain's past performance. They are also able to identify gaps and other imbalances between the plans. In order to resolve the gaps, the most advanced tools can also carry out what-if modeling, which can evaluate the effect of different scenarios to the company's KPI's. In addition, the solution should

have interfaces to company's other important IT-systems like ERP, CRM and accounting systems and be able to seamlessly share the information across the firm (Grimson & Pyke, 2007; Prokopets, 2012) All in all, the S&OP tools should be updated automatically and in real time, be able to compare and optimize company's plans, show information on past performance, have interfaces to company's other IT-systems and conduct scenario analysis.

When it comes to data quality and format, there are also some things that should be kept in mind. Most importantly the data should be perfect and clean (Boyer, 2009) as well as accurate, updated frequently and to have appropriate content (Tuomikangas & Kaipia, 2014). There should also be integrated and real time data as well as external data from suppliers and customers (Tuomikangas & Kaipia, 2014). Format for the data that the S&OP process uses, should be agreed on together (Boyer, 2009; Tuomikangas & Kaipia, 2014). This means deciding on how the sales, inventory, backlog and capacity data should look like and how it should be presented. The data hierarchy should also be agreed on. This helps to mine the data in the desired format. (Boyer, 2009) Common validation and interpretation of data is essential in order to keep the data easy to analyze further and support the executives in the decision-making process.

Like already mentioned before, high-end software is not a prerequisite for the success of S&OP process. Especially in the early steps of the implementation simple spreadsheet will serve the purpose just fine (Thomé et al., 2012). Some companies use playbooks or dashboards to facilitate and manage the meetings and the overall S&OP process. Playbooks bring consistency to decision-making and sets the foundation for measuring the effects of the decisions made (Singh, 2010). The idea is that the playbooks would include all the different scenarios that the company might encounter, and they would be already evaluated beforehand, which remarkably cuts down the preparation time during the S&OP process. Dashboards on the other hand review the adherence to plans by comparing planned and effected demand, production and inventory. They also present forecasting accuracy figures. In addition, dashboards can also visualize trend reports, exception reports and performance to support continuous improvement (Prokopets, 2012).

Schorr (2007b) refers to the playbook or dashboard as S&OP packet. The packet contains the essential management information, which is required for decision-making. The content is mostly visual information in the form of KPI's, family-by-family summary of the trends, changes, assumptions, financial impacts and recommendations as well as gaps to the business and strategic plans.

It has been noticed that building robust S&OP tools and standardized data formats is not easy even for advanced S&OP process companies. Difficulties appear most commonly in designing what-if modeling, data interfaces and performance reporting (Prokopets, 2012). However, it should not be forgotten that tools will never eliminate the need for a human judgement (Grimson & Pyke, 2007).

### **3.5.2 Performance Management**

According to Iyengar & Gupta (2013), every process needs metrics in order to manage and guide the performance of the process and every used metric should also have a specific purpose. With the help of proper metrics, the executives can build confidence in the process and they also make the process disciplined and transparent. Singh (2010) argues that every S&OP decision should be based on financial metrics that are driven by senior management of the company. This refers to the need to clearly map the metrics to be used as well as to define metric hierarchy.

Right metrics drive right behaviors, which makes them essential in company-wide processes that involve many different functions, like S&OP process (Iyengar & Gupta, 2013). Because of the cross-functional nature of S&OP process, the used metrics should review performance and drive accountability across all the functions involved (Iyengar & Gupta, 2013). Prokopets (2012) and Cecere (2009) also highlight the importance of assigning accountability of reaching the targets measured by the metrics. Cecere (2009) also states that the metrics should be shared and aligned and that S&OP team members should be jointly accountable for the metrics and agree with the vision of success. In addition, the metrics should be specific quantifiable goals with defined timeframes (Prokopets, 2012). Boyer (2009) also highlights that the metrics should be reviewed monthly.

One of the main goals of S&OP is the balancing of demand and supply and by reaching this goal also operational improvements, like forecast and inventory improvements, enhanced management of product mix and production volumes and improvements in the use of capacity resources in companies, have been achieved (Thome et al., 2011). In order to track these performance improvements, it is self-evident that metrics are needed. According to Iyengar & Gupta (2013), the success of any process depends on periodic gate reviews where future actions are agreed based on predefined metrics.

Tuomikangas & Kaipia (2014) divide performance management into five parts. These are financial, operations and process performance, target setting and follow-up process.

This grouping was used to collect and gather together different metrics identified from the literature. The found metrics can be seen in Table 3.

**Table 3. Metrics used in S&OP process.**

<b>Source</b>	<b>Financial performance</b>	<b>Operations performance</b>	<b>Process performance</b>
Tuomikangas & Kaipia (2014)	Profit, revenue, costs, EVA	Order fill rate, On-time delivery, delivery time. forecast accuracy, quality measures	Auditing the S&OP itself, planning efficiency, learning effects
Grimson & Pyke (2007)	Profitability, development costs	Operations responsiveness to sales plans, forecast accuracy, capacity utilization, time to market, ramp-up time, nr of successful introductions	360-degree feedback, feedback from peers, supervisors, subordinates, suppliers, customers
Prokopets (2012)	Working capital improvement, cost reduction	Customer or product growth, forecast accuracy improvement, supply gap reduction	Process participation
Boyer (2009)	Decreased costs	On-time shipments, reduced inventory, sales forecast accuracy, fill rate, past due backlog, excess and obsolete inventory	Document the process: agenda, calendar, S&OP document
Cecere et al. (2009)	Revenue, profitability	Forecast accuracy, perfect orders, inventory	

Source	Financial performance	Operations performance	Process performance
Thomé et al. (2012)	Production costs, distribution costs	Inventory (days of inventory, stock value), rate of obsolete inventory, order fill rate, cash-to-cash cycle time, capacity utilization, variation in production, on-time delivery, customer satisfaction/retention, delivery speed	
Iyengar & Gupta (2013)	ROCE, Brand-Turn-Earn Index, COGS%, inventory costs, financial forecast accuracy	Forecast Variances, Fill rates, Days of inventory on hand, Forecast accuracy, Customer fill rates, Distributor DIOH, NPD Schedule Adherence, Production plan adherence	Achievement of Plan

In the literature, the importance of having measurements and metrics applied to both company performance and S&OP process effectiveness is seen essential (Grimson & Pyke, 2007; Boyer, 2009; Tuomikangas & Kaipia, 2014) Especially the latter one is rarely measured (Grimson & Pyke, 2007) but is important to be able to show the success of the process (Boyer, 2009). As seen from Table 3, Boyer (2009) emphasizes the importance of documenting the process. This includes the agenda, calendar, S&OP document as well as an overall description of the whole process, its key steps and roles and responsibilities. This is important, in order for people to understand and follow the process as well as to show up and do the preparations required by them.

Cecere (2009) argues that one of the biggest mistakes that can be done regarding performance management is to have too many metrics. It is evident that if this happens, the focus can be easily lost to irrelevant details or it can also indicate that the company is not able to define clear goals for their operations. Hence, the company does not know where it is heading. It can be seen from Table 3 that the used metrics vary from author to author. This shows that there cannot be identified one clear set of metrics that should



be used. The used metrics clearly depend on the process goals, which can vary by industry and company.

### **3.5.3 Culture and Leadership**

It has been noticed that a strong S&OP culture leads to better coordination outcomes within the S&OP process (Goh, 2019). When it comes to culture and leadership, four distinctive factors were identified from literature that support the creation of strong S&OP culture and leadership. These factors are the importance of excellent leadership capabilities, commitment and respect, continuous improvement and training.

In companies that are on very advanced level when it comes to S&OP, there is a formal team in place with executive participation. Everybody knows the importance of negotiations done during the process and that the decision are always aiming at more profitable outcome for the company. (Grimson & Pyke, 2007) In order to S&OP process be in place and be supported, top management support (Boyer, 2009) with excellent leadership capabilities is essential (Grimson & Pyke, 2007). The importance of good leadership comes before any software or other tools. According to Boyer (2009), the leadership capabilities include the authority to commit resources like money and people's time, ability to champion, learn and design the process as well as teach others.

In addition to having excellent leadership capabilities, commitment and respect plays a vital role in the organizations practicing S&OP. Organizations must demonstrate discipline in adhering to the decisions made during the S&OP process (Prokopets, 2012). Sticking and carrying out the decisions as well as conducting follow-up actions is a vital part of the process and shows commitment and build trusts in the organization. High emphasis should be put into building mechanisms that foster trust and confidence among the S&OP team but also between the S&OP team and other entities within the company (Thomé et al., 2012). If S&OP is not understood or respected in the company, it hardly is receiving enough attention from the senior management and, hence, can suffer from lack of resources. However, it is not enough that commitment and respect is shown from the top down, also the individuals participating in the process should show commitment to the process, team and company by showing up and delivering what is promised (Boyer, 2009).

Continuous improvement is something that should also be built into the S&OP process (Iyengar & Gupta, 2013). Since S&OP has representatives from many different functions, the diversity of perspective is naturally very high. This kind of environment is very fruitful for sharing ideas and giving feedback and therefore perfect environment for coming up

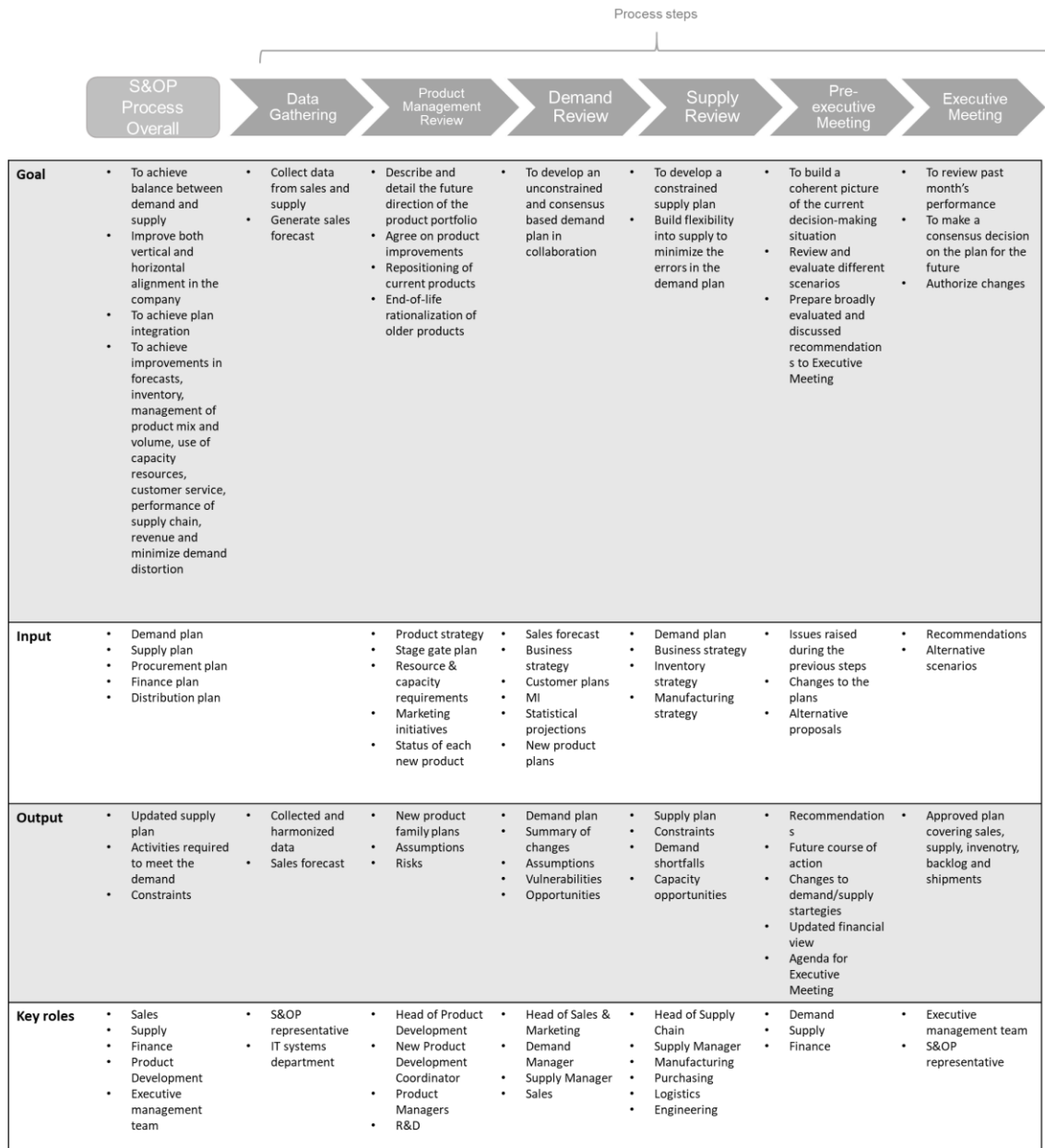
with improvement actions. Because of the cyclic nature of S&OP process, the ideas are also easily to be implemented during the process cycles. The fact that the improvement ideas come from inside the S&OP team motivates the participants and encourage them to take ownership, which is also an essential part in the success of the process.

Schorr (2007f) implies that one way to ensure about continues improvement is to have a meeting critique in the end of the executive meeting. The goal of the critique is to find out are the right things being done and how well are they being done. In other words, to ensure that the decision-making capabilities in the organization are always on high level.

The last factor that supports the creation of strong S&OP culture and leadership is training. Even people in very high roles in the organization might not understand the role of S&OP, which shows that the process is not that widely recognized. Everyone who is involved in the design, participation of the meetings or who will be directly affected by the output of the process should be educated about the process. (Boyer, 2009) Boyer (2009) suggests that the training should be interactive process where the participants can learn both form the subject matter and from each other. Giving access to the documentation of the process also helps to educate the relevant people.

### **3.6 Execution Framework for Make-to-Stock environment**

Based on the theory presented earlier in this chapter, an execution framework for S&OP in MTS environment was formed, which also serves as the summary of the literature review. The framework consists of two parts: S&OP process structure (Figure 5) and S&OP best practices (Table 4).



**Figure 5.** S&OP process structure in MTS environment.

The first part of the framework, the S&OP process structure in MTS environment, presents the S&OP process step by step as well as goals, inputs, outputs and key roles for each process step. The second part of the framework, the S&OP best practices in MTS environment, introduces the key focus areas related to the execution of S&OP and best practices related to these.

**Table 4. S&OP best practices in MTS environment.**

Area of focus	Best practices
Planning parameters	<ul style="list-style-type: none"> <li>- Create clear distinction between long term strategical and short term operational planning</li> <li>- Planning horizon 6-18 months</li> <li>- Consideres both volume and mix planning on product family level</li> <li>- Process has monthly cadence</li> <li>- Calendar agreed long beforehand</li> </ul>
Strategic alignment	<ul style="list-style-type: none"> <li>- Plans are derived from the business and strategic objectives of the company</li> <li>- Two way communication between strategic goals and operational plans</li> <li>- Process needs to be driven from top-down</li> </ul>
Cross-functionality	<ul style="list-style-type: none"> <li>- Process requires cross-functional team</li> <li>- Create functional integration within the organization and with suppliers and customers</li> <li>- Have formally defined process</li> <li>- Define the formal structure of S&amp;OP organization</li> <li>- Define roles and responsibilities</li> <li>- Assign authority</li> <li>- S&amp;OP organization should be accepted as a function in the organization</li> <li>- The process needs to be managed as continuous process, not as a episodic decision-making tool</li> </ul>
Roles & responsibilities	<ul style="list-style-type: none"> <li>- S&amp;OP team should consist of representatives from sales, marketing, demand planning, supply planning, finance, procurement and IT</li> <li>- Have a strong senior executive support and sponsorship</li> <li>- Have a clear governance for the process, S&amp;OP leader/coordinator</li> <li>- Organize trainings for the key positions</li> </ul>
Tools & data	<ul style="list-style-type: none"> <li>- Together agree with the data format and data hierarchy</li> <li>- Use of playbooks and/or dashboards can help to manage the process</li> <li>- Build S&amp;OP tools that are <ul style="list-style-type: none"> <li>• Automatically updated</li> <li>• In real time</li> <li>• Able to compare and optimize company's plans</li> <li>• Show information on past performance</li> <li>• Have interfaces to company's other IT-systems</li> <li>• Conduct scenario analysis</li> </ul> </li> </ul>
Performance management	<ul style="list-style-type: none"> <li>- Have metrics for both company and S&amp;OP process performance</li> <li>- The used metrics should review performance and drive accountability across all the functions involved</li> <li>- Beware of having too many metrics</li> <li>- Document the process <ul style="list-style-type: none"> <li>• Agendas of the meetings</li> <li>• Process calendar</li> <li>• Overall process description with roles and responsibilities</li> </ul> </li> </ul>
S&OP culture & leadership	<ul style="list-style-type: none"> <li>- Top management support with excellent leadership capabilities</li> <li>- Commitment and respect from the participants</li> <li>- Adherence to the decisions made</li> <li>- Continuous improvement built into the S&amp;OP process</li> <li>- Educate people who will be directly affected by the output and give access to the documentation of the process</li> </ul>

## **4. EMPIRICAL RESULTS**

This chapter presents the results of the empirical part of the thesis. The aim of the empirical study in this thesis was to build a coherent picture of the requirements of ETO context to the execution of S&OP, and thus modify the initial construction presented in Chapter 3 to the needs of ETO environment. This was done by conducting interviews and observation in the case company together with studying of existing secondary material. The empirical data gathered was analyzed and the results of the different data sources were used to supplement each other and as a result a comprehensive picture of the ETO specific needs to S&OP execution was gotten. As a result of the findings presented in this chapter, a construction in the form of a framework for S&OP in ETO context was formed.

The result chapter starts by describing the key characteristics of the operating environment of the case company. Next, a synthesis of the empirical data analyzed is presented with the help of the framework constructed in Chapter 3. The framework is used to describe the S&OP process and best practices related to its execution as well as to identify differences and similarities between the S&OP processes in different contexts. Furthermore, the biggest differences and similarities between the S&OP processes in MTS and ETO environment are summarized. Finally, the relation between the differences identified and the key characteristics of the business environment is studied.

### **4.1 Key Characteristics of the Operating Environment of the Case Company**

To be able to critically evaluate and understand the results of this research, the context and the characteristics of the case company's operating environment need to be understood well. The business environment of the company is analyzed with the help of the ETO framework presented in Figure 1. Product portfolio, characteristics of the markets and characteristics of the production environment are covered. The key characteristics are summarized in Figure 6.

The division of the case company, which is the focus of this research, has a wide product portfolio consisting of tens of unique product models, which are manufactured in Tampere PU. Notable is that approximately 15% of these are products that are still in prototype phase and 10% that are in production ramp up phase. In addition, all the product models are highly customized, and the selection of different options is counted

in hundreds. Hence, it can be said that the product portfolio is complex and there is a high emphasis on introducing new models to the markets as well as having good capabilities in responding to various customer needs.

Because of the high number of different product models and options, also the amount of different parts and materials used in the production is vast. In addition, the material lead times can be long (up to 6 months) for some of the parts. These factors pose a challenging setting for the company's procurement and sourcing functions.

In addition to long material lead times, also the assembly lead times in the case company are long. This is due to the high complexity and variety of the products and the amount of engineering effort and final testing the products require. When combining the complexity of sourcing with the complicated and time-consuming assembly it can be argued that the supply chain as a whole is complex, which has a big effect on the operations of the case company from all the way from forecasting to the delivery of the finished product.

The industry in which the company operates in, generally is very volatile and highly affected by the development of commodity prices. In addition, the demand volatility is the result of the customer companies habit to react very abruptly to signals and changes in the markets. In other words, the customer behavior is very hard to predict, which makes the demand forecasting a challenge.

The case company has sales in all continents and in more than 160 countries in total. The company operates with 14 sales areas with one Area Manager assigned to each sales area. Sales Director coordinates the global sales operations and has a coherent picture of the demand globally. It can be said that together with unpredictable customer behavior and widespread sales operations, the demand planning is a challenge in the case company.

To be able to react to the demand fluctuations, the production environment needs to be flexible. The case company uses multiple different flexibility actions to optimize their production costs while maintaining the ability to be agile. These actions include the use of satellite productions, rental production spaces, rental workforce, material buffer stocks, adjustable material buffer times. In addition, the production is a combination of assembly line manufacturing and positional assembly, which supports the manufacturing of a variety of different products with different throughput times. The company has also separated its proto manufacturing by having both blue- and white-collar workers dedicated just to proto and ramp up manufacturing.



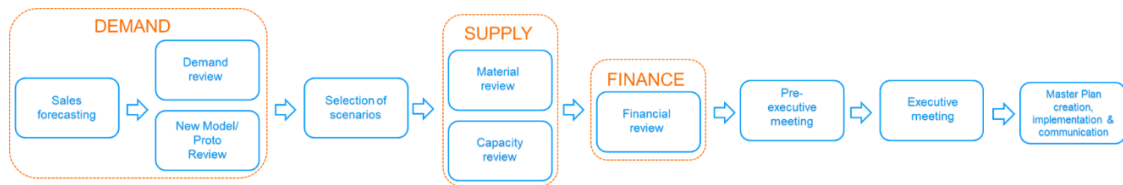
**Figure 6.** Key characteristics of the operating environment of the case company.

When comparing the characteristics of the operating environment of the case company with the ETO framework in Figure 1, a lot of similarities can be found. Hence, it can be said that the operating environment of the case company can clearly be characterized as ETO environment.

## 4.2 Sales and Operations Planning Process

The S&OP process studied in this thesis is carried out locally on the production unit level in Tampere. The overall structure of the S&OP process is the same in the whole division globally, but the production units can decide themselves how they carry it out and the plans are made and agreed on locally. However, one of the executives interviewed argues that the S&OP process should be carried out on global level since there are strong synergies between the production units.

The S&OP process is part of the company's Forecast, Order & Delivery (FOD) process, which encompasses all the processes from demand planning all the way to the delivery of the finished product. The S&OP process structure is illustrated in Figure 7 and more detailed swim lane chart of the process can be seen in Appendix A.



**Figure 7.** S&OP process in the case company.

The overall process and the process steps are described using SIPOC model. This means that first it is explained who the suppliers (S) of the inputs to the process step in question are. Second, the process step inputs (I) are described after which the value creating activities of the process step are explained. In other words, the process (P) of the process step is elaborated on. After this, the output (O) together with the customer (C) aka receiver of the output are defined. (Gueorguiev, 2018)

In the case company's material, the S&OP process is defined as process aiming at producing a long-term production plan referred to as Master Plan with the right volume and product mix to secure good product availability with decent lead times while maintaining cost efficient production chain. One of the interviewees refers to the S&OP process as the "backbone of the supply operations".

The process starts by reviewing the future demand and forming a demand plan, based on which scenarios of the future production volumes and product mix will be made. The scenarios are then evaluated from the supply and finance point of view, which means assessing possible material and capacity restrictions together with financial implications. Thoroughly discussed scenarios are then presented to Executive team who make the final decision on the production plan volume and product mix. Final part of the process is communicating the new plan to all relevant stakeholders

The process utilizes inputs like sales data, financial forecast, current production plan and finished goods stock levels. These inputs are supplied either by sales, production planning or finance. The output, on the other hand, is the Master Production Plan for the next fifteen months. The customer of this process is the process of supply planning, hence, the production planning function.

#### 4.2.1 Sales Forecasting

The first step in the S&OP process in the case company is sales forecasting. Among the interviews conducted, the goal as well as the responsibilities related to this process step are widely agreed on. It is clear that the main responsibility of this process step belongs to sales. The goal of this process step is to collect the demand and complete the sales



forecast in the company's CRM system in order to prepare for the demand review -meeting.

The suppliers for this process steps are Area Managers, who collect the demand with the help of Business Line Managers (BLM's). Hence, the input of this step is the market insight and outlook for the next twelve months as well as a coherent picture of the customer needs. There is one BLM assigned for each sales area and they work in frontline. Area Managers, on the other hand, are situated in backline and one Area Manager is responsible of coordinating the sales of one sales area.

The sales forecasting starts with Area Managers and BLMs discussing about the sales forecast together and deciding what should be included in it. After this the numbers are manually updated to the sales forecasting tool in the company's CRM. Final part of this process step is the preparation for the demand review -meeting. This includes preparing the Power BI -report, which summarizes and visualizes the sales forecast together with the current production plan as well as preparing an excel file to be used to build the demand plan during the next meeting. This technical preparation is done by the S&OP Manager. The sales team is expected to prepare to present their needs in the demand review with the help of the above-mentioned Power BI -report. The interviews from the sales representatives highlight the importance of agreeing and communicating beforehand what needs to be included to the forecast. In other words, should the forecast reflect the unconstrained demand or the constrained demand. Common understanding of the purpose and use of the forecast increases motivation within the sales team in fulfilling the tasks required by them.

The output of the sales forecasting -step is the sales forecast -report, which shows the needs of all the company's sales areas for the next twelve months. Sales forecast is the rolling twelve-month equipment forecast, which includes the monthly volumes of each product model and is based on the ex-works month from the PU. The monthly volume consists of supply pipeline (orders + reservations received) + forecasted units. The customer of this process step is the S&OP Manager, since he is the one conducting the next meeting where the sales forecast acts as an input.

The sales forecasting -step as such does not exist in MTS environment. However, it is included in the data gathering -step, which is not part of the process in the case company. Only the collection of sales forecast is seen as part of the S&OP process because that is the only source of data that is uniquely collected and used in this process only. The other data used during the process is collected as part of or for some other key processes and then taken advantage of during the S&OP process. In MTS environment, IT can be

one of the parties responsible of the data gathering while in the case company IT is not considered as part of the process at any point.

#### **4.2.2 New Model Review**

After the sales forecasting comes the new model review -meeting. The selection of products reviewed in the meetings creates the distinction between demand review and new model review. Only the products that have by passed the proto and production ramp up phase are reviewed in the demand review -meeting while the rest in the new model review -meeting. The reviews are held separately since there are different sources of information needed depending on the novelty status of the product. The Product Managers and Project Management Office are consulted regarding the demand of new models while the sales team is responsible of communicating the demand for products already in production.

The ultimate goal and purpose of the new model review is to comment and modify (if needed) the production plan for proto and ramp up models for the next 18 months based on the compromise between the demand needs and the production capabilities and restrictions. This process step is considered vital by NPD Manufacturing Manager and Production Planner to ensure that the production capabilities are sufficient to meet the demand of new products and that the production resources reserved for NPD projects are being used efficiently.

The suppliers for this process steps are the Product Managers and the PMO who together provide the NPD project needs based on which the production plan for the new models is built. In addition, production planning provides the other input for this process step, which is the current production plan.

The agenda of the meeting is to go through the current production plan of the new models model by model. The Product Managers together with the PMO are expected to impress their concerns if the current plan is not favorable and if new needs have appeared. Together with NPD Manufacturing Manager and representatives from production planning the plans are evaluated, discussed and agreed on.

The output of the new model review is the updated production plan for the proto and ramp up models for the next 18 months as well as the meeting memo. The timespan of the plan for the new models is longer compared to the volume products since the production and material lead times for the new models are considerably longer. In addition, they require more engineering effort. It was agreed by all of the interviewees that 18 months is a long enough time span for planning the production of new models.

The customer of this process step is the production planning who then implements the agreed plan. Unlike the output of the demand review, the output of the new model review is not evaluated or discussed further during the rest of the S&OP process. The new model plan is discussed and agreed on only during the new model review. However, if some critical issues arise during the meeting, they can be then escalated to the executive meeting if felt necessary.

When comparing this step between the S&OP processes in ETO and MTS environment, in MTS environment this process step is referred to as product management review. The difference between these two is that in product management review there are decisions made about new product launches as well as discontinuing an older product while in new model review the scope is on discussing and deciding on the production plan of the new models only. Hence, the agenda of the product management review is much wider than the one in new model review where the focus is purely on the new products.

In ETO environment, the new model review is considered important mainly due to the business environment characteristic of high share of new models in the product portfolio. In addition, another reason for having new model review as a separate step in the process in ETO environment is that the view of Product Managers and PMO is needed regarding the demand of the new models since the products are still in the project phase. When studying the process step in MTS environment, it was noticed that only few authors mentioned the existence of the product management review, which can refer to the fact that it is not seen as a vital part of the process.

### **4.2.3 Demand Review**

In parallel with the new model review, the demand review is held. While the previous process step is widely agreed on, more variable views arise regarding demand review and especially the responsibilities related to it. According to the interviews with the participants of this process step, the overall goal of the meeting is to form a coherent picture of the demand. In more practical level, this means consolidating the sales forecast and building an unconstrained demand plan in collaboration with the sales team. Since the earlier step, sales forecasting, is about collecting the sales area specific needs, the aim of the demand review is to build a global picture of these needs and build a global demand plan based on them. It was also agreed that the demand review is an integral part of the process, since it provides the main input for the whole process. Hence, effort should be put in developing it to ensure high quality of the demand plan.

When it comes to the responsibilities within this process step, the representatives of sales and supply have some varying views. It is agreed that the suppliers of this process step are Area Managers, Sales Director and production planning. Sales' responsibility is to provide the sales forecast and market insight while production planning provides the other input of the process, which is the current production plan together with history data on the delivered orders. However, supply's view is that it is the sales' responsibility also to conduct and facilitate the meeting as well as build the demand plan while sales representatives think that it is the responsibility of S&OP Manager who is part of the supply organization. The reason for sales to refuse carrying out these tasks is mainly due to lack of resources while the reason for the supply to try to push the responsibility to sales is the fear of having too much involvement from supply already at this point of the process. The need for an additional resource to analyze and build a coherent picture of the global demand arose from multiple interviews. Hence, it can be stated that if there were unlimited amount of resources available, everybody would agree that the responsibility of this process step would belong to sales.

Based on the observation conducted, the agenda of the meeting is to review the sales forecast by planning group and identify any gaps to the current production plan. Through discussion it is agreed what units will be added or removed and so is the demand plan built. Besides the sales forecast, other metrics that are reviewed to support the decision-making in the meeting are forecasting accuracy and order intake. Since the basis for the draft demand plan is the latest production plan, the demand plan is focusing on highlighting the changes made to the production plan.

The output of the demand review is a demand plan. The demand plan shows the monthly equipment volumes by planning group based on the ex-works month from the production unit for the next 15 months. The demand plan is based on the following factors: sales forecast, sales' knowledge and view on the active and strategic deals and market outlook. Hence, it should reflect the true needs of the market. The customers of this process step are the S&OP Manager, Sales Director, Supply Chain Director and Operations Manager, since they are the ones being involved in the following process step: selection of scenarios.

When comparing the case company's S&OP process with the S&OP process in MTS environment, it can be seen that demand review is held in both cases in very similar way and with the same intention: to form a consensus-based demand plan, which reflects the true needs of the market. Hence, it can be stated that regardless of the operating environment, the demand needs to be understood well in order to continue further in the S&OP process, since it is the main input to the whole process.

#### **4.2.4 Selection of Scenarios**

After the demand has been reviewed comes the selection of scenarios -step. The goal of this process step is to agree on the volume and product mix scenarios that will be evaluated for the executive meeting. The selection of scenarios happens directly after the demand review -meeting.

The supplier for this process step is the S&OP Manager who provides the input aka demand plan to the process step's participants. The participants include Operations Manager, Sales Director, Supply Chain Director and S&OP Manager. Hence, the meeting can be considered cross-functional.

The agenda of this very brief meeting is to discuss if there are some additional volume and product mix scenarios that should be evaluated for the executive meeting on top of the demand plan. As an output of this process steps comes the selected volume scenarios. Usually there are 2-3 scenarios selected of which one is the demand plan and the other ones +/- 10% to the current production plan. The customers of the process step are the representatives from supply and finance who evaluate the selected scenarios. From supply these representatives are Sourcing Manager, Procurement Manager and Manufacturing Manager and Production Planner and from finance the Finance Director.

This process step has been added as part of the S&OP process in the case company due to the nature of their business. It is considered as an important collaboration step between sales and supply by both of the parties. In the case company, the demand is very demanding to forecast and to reduce the impact of inaccurate forecasts and, hence, an inaccurate demand plan, multiple different scenarios are usually chosen to be evaluated for the executive meeting. This ensures that the best possible option for the production volume and product mix, considering all the three aspects: demand, supply and finance, can be found.

Selection of scenarios -step does not exist in the S&OP process structure of MTS environment, which is a major difference between the two processes. The difference can be explained by the characteristics of the business environments. Demand volatility and difficulty to forecast in ETO environment encourage to more careful scenario analysis, which is the reason for having this step as part of the process.

#### **4.2.5 Material Review**

The goal of the material review is to receive comments and evaluation from the representatives of sourcing and procurement regarding the volume and product mix

scenarios received as an outcome of the previous process step. This view was shared by all the interviewees answering questions about the material review.

The supplier of this process step is the S&OP Manager who communicates the selected scenarios to Sourcing and Procurement Managers. Hence, the scenarios serve as an input for this process step. It was highlighted by Procurement Manager that the scenarios should be communicated by planning group, preferably even on product level, and the delivery volumes should be presented as monthly volumes. In addition to the scenarios, supplier flexibility strategy, which indicates the different actions required to reach certain production volumes, serves as another input to this process step.

During this process step, based on the volume and product mix scenarios Sourcing and Procurement Managers conduct analysis on how the scenarios affect component stock levels, material availability and supplier capabilities. As an outcome of the analysis, an answer to the following questions should be gotten:

- How is the component stock affected?
- How is the material availability affected?
- Are there some restricting suppliers/parts?
- What actions are required to overcome these restrictions?
- In what timeframe and at what cost can these restrictions be overcome?

One of the interviewees summarized the goal of the material review by saying: "The outcome of the meeting is either yes or no, to the question of are we able to execute the proposed plan".

After the analysis, they fill in the related slides on the S&OP pp-presentation provided in the S&OP SharePoint. In addition to the previously mentioned topics, they also provide summary comments to the end of the presentation including supporting and opposing factors for each of the scenarios from the material perspective. Hence, the output of the process step is referred to as material action plan and constraints. Several interviews highlight the importance of communicating the timeframe and the cost related to the actions required to fulfil the scenarios as the output of the material review. The customer of the material review is S&OP Manager since he is the one that combines all the analysis into one presentation and then facilitates the pre-executive meeting.

The material review as itself does not exist in the S&OP process structure of MTS environment. In the case company, the supply review has been broken down into three distinctive parts: material, capacity and financial review whereas in MTS environment material and capacity related issues are discussed in the supply review. Furthermore,

the financial aspect is discussed not until the pre-executive meeting. The justification for the separation is that in ETO environment both the material and capacity planning can be considered complex and, hence, the analysis required from them demands a lot of effort. To ensure that the right and sufficient amount of resources are assigned to these tasks, separate process steps were created. Also, the financial analysis is wanted to be made prior to the pre-executive meeting to enable more efficient and beneficial meeting.

Another distinction between the two processes is that in MTS environment, there is only the demand plan that will be evaluated while in the case company there can be multiple different scenarios on top of the demand plan to be evaluated. This is to ensure that the best possible decision is made regarding the volume and product mix in the demanding and fluctuating market that the case company operates in as well as to be prepared to execute multiple different scenarios.

#### **4.2.6 Capacity Review**

The capacity review happens parallel with the material review. The goal of the capacity review is to receive comments and evaluation from the representatives of manufacturing and production planning regarding the volume and product mix scenarios received as an outcome of the previous process step.

The supplier of this process step is the S&OP Manager who communicates the selected scenarios to Manufacturing and Production Planning Managers. Hence, the scenarios serve as an input for this process step. In his interview, Manufacturing Manager highlights the importance of having a high-quality input. This means that the product mix and product volumes should be specified as precisely as possible, since the product mix has a great impact on the possible actions required to meet the demand and remove restrictions. In addition to the scenarios, capacity flexibility strategy, which indicates the different actions required to reach certain production volumes, serves as another input to this process step.

During this process step, based on the volume and product mix scenarios Manufacturing and Production Planning conduct analysis on how the scenarios affect the total workload and production capabilities including facilities, staff and knowledge. As an outcome of the analysis, an answer to the following questions should be gotten:

- How is the production load affected as hours and FTE (Full-time equivalent)?
- Are there some actions required to meet the new production load?
- In what timeframe and at what cost are these actions doable?

After the analysis they fill in the related slides on the S&OP pp-presentation provided in the S&OP SharePoint. In addition to the previously mentioned topics, they also provide summary comments to the end of the presentation including supporting and opposing factors for each of the scenarios from the capacity perspective. Hence, the output of the process step is referred to as capacity action plan and constraints. Based on the interviews of the supply representatives, the most important pieces of information that should be communicated forward are the timeframe and price tag together with possible restrictions for fulfilling the proposed plan. According to Manufacturing Manager: "The answer should never be no. In some timeframe and at some cost the scenarios are always doable, and these facts should be communicated forward. Then it is up to the executives to decide if the investment is worth it." The customer of the capacity review is S&OP Manager since he is the one that combines all the analysis into one presentation and then facilitates the pre-executive meeting.

Like mentioned when discussing about the previous process step, the capacity review does not exist in the S&OP process of MTS environment, but the same issues are discussed during a process step referred to as supply review. Reasons behind this are elaborated on in the previous sub-chapter.

#### **4.2.7 Finance Review**

The financial review is conducted after the material and capacity reviews. The goal of the finance review is to receive comments and evaluation from the representatives of finance on the volume and product mix scenarios. The ambition is to get monetary evaluation on the effects of implementing a certain scenario as well as increase understanding on the effects on financial measures of the company. In other words, the profit expectations should be compared with the costs and risks related to the execution of the plan. This remarkable facilitates the executives in the decision-making in later steps of the process.

Currently, finance review is not carried out in the case company in the extent wished for. It has been discussed within the executive team and the importance of implementing it is seen important among them. The importance of integrating finance as part of the S&OP is also highlighted in several interviews. There are discussions ongoing in the case company on how this should be carried out in practice. In addition, it was brought up in the interview with Supply Chain Manager that risk analysis should be part of the S&OP agenda. In other words, the monetary evaluation of risks associated with each scenario should be part of the finance review.



The supplier of this process step is the S&OP Manager who communicates the selected scenarios to Finance Director and Finance Controllers. Hence, the scenarios serve as an input for this process step while the financial impacts serve as the output. Other inputs include finance data on pricing and profits. Finance Director together with Finance Controllers are responsible of carrying out the analysis. The customer of the finance review is the S&OP Manager since he is the one that combines all the analysis into one presentation and then facilitates the pre-executive meeting.

Finance review is not separately held in MTS environment. However, it is mentioned that representatives from finance are present in the pre-executive meeting, but the finance analysis nor the risk analysis is not emphasized in the extend done in the case company. Based on the interviews, it can be argued that the uncertainty present in ETO context together with the high costs associated with material purchases and inventory management encourage to place high emphasis on financial evaluation and risk analysis.

#### **4.2.8 Pre-executive Meeting**

After the thorough evaluations of scenarios by materials, capacity and finance, the pre-executive meeting is held. The pre-executive meeting can be also referred to as collaborative summary meeting or rehearsal for the executive meeting. It is agreed by most of the process step participants that the goal is to go through the evaluated scenarios with the help of the S&OP pp-presentation and in the end reach a consensus on what will be presented in the executive meeting. In addition, one of the scenarios should be selected as the proposal to be recommended to the executive team. Having a clear proposal was highlighted in several interviews. In his interview, Finance Director mentions that one goal of the meeting is also critically evaluate and ensure on the data quality.

The responsibilities related to this process step are agreed with all of the interviewees. The supplier of the pre-executive meeting is the S&OP Manager who facilitates the meeting and finalizes the S&OP pp-presentation including the outcomes of the material, capacity and finance reviews. Hence, the S&OP presentation including the documentation from the scenario analysis can be seen as the input of the pre-executive meeting.

Based on the observation conducted, the agenda of the meeting is to go through the S&OP presentation and discuss the different scenarios. The participants of this meeting include S&OP Manager, Operations Manager, Sourcing Manager, Procurement

Manager, Finance Director, Manufacturing Manager, Order Desk Manager and Production Planner. It is essential to have a cross-functional team present in this meeting to ensure comprehensive discussion and views from all the relevant functions. After the run-through, one of the scenarios is chosen as the proposal to be recommended to the executive team.

The customer of this process step is the executive team to whom the output of the pre-executive meeting is delivered to after the meeting. This is done to allow the members of the executive team to prepare themselves before the executive meeting. The output of this process step is the reviewed S&OP presentation and proposal.

When comparing the pre-executive meeting process step between ETO and MTS environment, it is evident that they are very similar. The main goal in both cases is to go through the analysis conducted and discuss any issues or constraints raised from that and in the end, agree on the proposal to be presented to the executives. Also, the inputs, outputs and key roles align between the processes.

#### **4.2.9 Executive Meeting**

The executive meeting acts as the final meeting in the S&OP process. It is a decision-making forum where the executive team discusses and makes a decision on Master Plan volume and product mix and authorizes actions related to the decision.

According to the interviews, the responsibilities related to this process step are clear. The supplier of this process step is S&OP Manager who first sends out the S&OP presentation to the executive team two business days prior to the meeting and also facilitates the meeting. Several interviewees see the importance of sending the S&OP presentation to the executive team in advance. The role of the executives is to have the accountability of the process step and be responsible of reaching a decision.

The reviewed S&OP presentation together with the action proposal can be considered as the input of the executive meeting. Both Finance Director and Supply Chain Director, who are part of the executive team, emphasize the importance of having one clear proposal together with the other reviewed scenarios as an input to this process step.

The agenda of the meeting follows the agenda of the S&OP presentation. The goal is to keep the agenda of the meeting standardized from one S&OP round to another in order to enhance the efficiency of the meeting and ease the decision-making. Especially the efficiency aspect was seen important in the interviews. In practice, this means having the same content slides in the S&OP presentation on every round. One of the interviewees summarizes the agenda of the meeting by saying: "First, we try to

understand our current state and where we are right now. Then, we decide where we want to go.”.

Regarding the content of the meeting, three topics are highlighted in the interviews. First, there should be a short recap in the beginning of the meeting about the previous decisions made in earlier process rounds since it is important to understand the cumulative effect that these decisions might have. Secondly, in addition to just evaluating the demand, supply capabilities and financial impacts, the strategy aspect should also be addressed and discussed at some point of the decision-making during the meeting. Thirdly, it is vital to communicate and discuss the different risks related to the scenarios. Potential risks could be for example the loss of EBIT or market share. The risk evaluation is strongly related to the strategy aspect since it needs to be understood what the division’s strategy is related to risk taking to be able to make the right decision.

The customer of the process step is the production planning team within the supply organization in the case company since they implement the production plan changes approved by the executive team. Agreed Master Plan volume and product mix for the next 15 months serves as the output of this process step.

The executive meeting is considered as the final decision-making point in both the ETO and MTS environments and, hence, a vital part of the process. Regarding the process step inputs and outputs as well as the key roles, the two processes also align. Only part where there is a slightly difference between the processes is the content of the agenda. In the case company, it is highlighted in several interviews that strategy should be brought as part of the discussion and agenda in the executive meeting, while in MTS it has not seen to play that big of a role. The reason for the high emphasis on strategy aspect in ETO environment is the uncertainty of the markets and the difficulty to forecast customer behavior. Hence, strategical decision-making is required in order to decide what products should be manufactured and in what volume.

#### **4.2.10 Master Plan Creation, Implementation & Communication**

As the final step of the S&OP process Master Plan is created, implemented and communicated. These tasks happen directly after the executive meeting. The goal of these tasks is to maintain the company’s ERP system up to date and inform all the relevant stakeholders about the changes that were made to Master Plan.

The supplier of this process is S&OP Manager who acts as a messenger between the executive team and production planning. He delivers the output of the executive meeting

to production planning. Hence, the agreed Master Plan volume and product mix are the inputs to this process step.

The production planners are responsible of carrying out the tasks of this process step. According to the interview with Production Planner the process step can be divided into three distinctive parts: Master Plan creation, Master Plan implementation and Master Plan communication. First, Master Plan is finalized according to the decision made in the executive meeting. This means removing or adding units from or to the production plan and it is done to the Master Plan excel file. This file then serves as a guide when doing the plan implementation to the ERP system. Until this process step, all the planning has happened on the planning group level. When the production planners transfer the decision of the executive meeting into the actual Master Plan, they change the focus from planning group level to the product level.

Secondly, the ERP system is updated by manually adding or removing the needed units as stated in the Master Plan excel-file. Finally, after the plan implementation is done, the outcome the S&OP process round is communicated to the relevant stakeholders. The communication happens via email and it includes the following topics:

- Brief written summary of the outcome of the S&OP round
  - o i.e. outlook of the demand, how much was the Master Plan volume changed and reasoning behind the changes
- Visualization of OI and Order Backlog
- Visualization of Master Plan by delivery month
- Visualization of Master Plan by final assembly start month
- Changes to Master Plan from the previous month by planning group and delivery month, chart
- Changes to Master Plan from the previous month by planning group and final assembly start month, chart
- Master Plan excel-file as an attachment

The output of this process step is the Master Plan excel-file defining the detailed production plan of the production unit for the next 15 months. It was emphasized in several interviews that the new Master Plan should be implemented and communicated as soon as possible after the decision has been made in the executive meeting. The target in the case company is to communicate Master Plan within two business days after the executive meeting.

When considering the customer of this process step, it can be noticed that there is a large number of different stakeholders that can be seen as the customer since Master Plan has an effect on the daily work of many different functions in the company. These

functions are manufacturing, production planning, procurement, sourcing, sales, product development, finance and supply chain.

Communicating the output of the S&OP process is not considered as vital in MTS environment as it is in the case company, which is seen from the fact that only few authors mentioned it. The reason for this can be that the changes made as a result of the S&OP process are not expected to be major rather small adjustments to the production volumes. While in ETO environment the volatile demand can lead to sudden changes in the production volumes or mix, which can have a big effect on the daily work of many functions in the organization.

### **4.3 Planning Parameters**

In the case company, there are defined timeframes for the different planning activities. Short-term operational planning including production scheduling and resource requirements planning and allocation takes place up until six months into the future. This six-month period is also referred to as frozen period from the S&OP point of view since no changes are allowed to be made to this time period in the S&OP process. This is due to the fact that it is difficult or even impossible in some cases for the material and capacity planning to react to volume changes in such a short notice. Hence, the planning horizon for S&OP process in the case company is 6-15 months. For proto and ramp up models the planning horizon is extended to 18 months into the future, since those models require more engineering and sourcing effort and can have more long lead time items. The planning horizons and planning frozen period were agreed by all of the interviewees.

However, when discussing the planning horizons during the interviews, it was evident that deciding on the most suitable planning horizon and frozen period is not necessarily straight forward. In his interview, Manufacturing Manager explains how the planning horizon should be decided on. First, it needs to be understood how the output of the process (Master Plan) is used by different functions. For example, sourcing and procurement uses it to build a supplier forecast and manufacturing uses it to plan their capacity. Hence, the throughput time of the whole supply chain together with the lead time targets should define the planning horizon. It should be an operations strategy related decision and flexibility actions such as component buffer stocks can be used to create flexibility to the product lead times.

In the S&OP process, both volume and product mix planning are done at the planning group level. This simplifies the planning effort since the product portfolio in the case company is very large. The products are grouped into the planning groups according to

their application mode and abilities. Altogether 19 planning groups are used. The planning group level is agreed to be sufficiently precise for the S&OP process needs by all the functions participating in the S&OP process. However, Procurement mentioned that if the planning was done in product level that would increase the quality of their input to the process but planning group level is detailed enough.

The S&OP process is carried out monthly and it takes a bit over two weeks to run through the whole process. The calendar for the S&OP process, covering the dates and times for the meetings, is usually agreed a year beforehand and it is published in SharePoint to the process stakeholders. In addition, meeting invitations are sent out months in advance to reduce the possibility of overlapping meetings.

To summarize, the planning horizon for S&OP process in the case company is 6-15 months for the volume products and 6-18 months for the proto and ramp up products. These planning horizons do not dramatically differ from the recommendation for MTS environment, which is 6-18 months. Due to the demand fluctuations and difficulty to forecast the timeframe of 6-15 months is justifiable for volume products in the case company. The case company utilizes frozen period in planning, which spans from the current moment up until six months into the future. The use of frozen period is justifiable due to the long material and assembly lead times in the case company. In MTS environment the frozen period is not used.

In the case company, planning is carried out on planning group level, which reduces the challenges faced with the complex product portfolio and high level of customization. Whereas in MTS environment where the product variety can be smaller also SKU or product level planning can be considered. Furthermore, the fact that the S&OP process has a monthly cadence in the case company is in line with the MTS S&OP process guidelines.

## **4.4 Sales and Operations Planning Organization**

The organizational aspect of S&OP has been divided into three aspects: strategic alignment, cross-functionality and roles and responsibilities. Each of these has an impact on the success of S&OP.

### **4.4.1 Strategic Alignment**

The overall business objectives of the case company are well known and communicated within the organization. The business area specific goals and strategy are derived from these group level objectives. The same way are the division specific goals derived from

the business area's objectives. Each function in the division is then responsible of formulating their own targets and strategy. The way the objectives and strategy are driven from top down in the case organization ensures that the goals are aligned throughout the company. However, since S&OP is not accepted as its own function in the company, no formal business objectives have been defined for it. The lack of specified objectives is also stemming from the fact that there are no meters in place to measure the effectiveness of the process itself.

This weakness has been noticed in the case company and S&OP process specific targets and metrics are under development. It is understood that in order to be able to demonstrate the value of the process as well as develop it further, some goals and metrics need to be in place.

Strategy is not separately discussed during the process execution in the case company. However, it can be noticed that it is reflected on the decisions made by the executive team. In other words, the decision made in the executive meeting are clearly based on certain strategic intention, which enables the strategy to be transferred into the operational plans of the company. Nonetheless, based on the interviews, the lack of strategic discussion during the executive meeting has been noticed and according to two of the interviewees it should be part of the agenda of the meeting.

In order to sustain and enhance the strategic focus of the S&OP process, it has a strong executive support in the case company. This can be noticed from the facts that the members of the executive team prepare before the executive meeting by studying the S&OP presentation provided ensuring better quality of the decision-making and they are also involved in the development of the process by providing comments and direction. It has been acknowledged in the case company that the executive support is a prerequisite for the process to receive the needed resources and dedication from the process participants.

To conclude, the strategy of the case company is derived from top-down in the organization and it is reflected in the decisions made in the S&OP process. However, the strategical guidelines should be made more visible during the process. One way to do this is to make strategy discussion as part of the standard agenda of the executive meeting. To sustain the strategic focus of the process in the case company, it has a strong executive support. The above-mentioned findings do not significantly differ from the MTS S&OP process guidelines. Hence, it can be said that having strategic alignment is seen important regardless of the operating environment. However, fluctuating demand

together with the difficulty to forecast in ETO environment increase the importance of having clear vision and strategy on how to run the business.

#### **4.4.2 Cross-functionality**

The S&OP process in the case company is accompanied by a cross-functional team. In other words, the process receives inputs from multiple different functions, which serves as a good basis for decision-making. It is not self-evident that cross-functional team functions smoothly. The factors that have made it work in the case company include clearly defined process together with defined roles and responsibilities, assignment of authority, continuous process and establishment of good communication channels. Especially the importance of good communication channels and good connection between the stakeholders is emphasized in several interviews as a prerequisite for the cross-functional collaboration to work.

The S&OP process in the case company is clearly defined and documented in the Integrated Management System (IMS). The documentation includes visual process chart with detailed description of each process step together with RASCI model (see 4.4.3). This ensures transparent process and decision-making. Defined roles and responsibilities are a prerequisite for successful collaboration since it is important to understand what each of the process participant is expected to deliver.

To ensure involvement and commitment from all the relevant functions, authority needs to be assigned. Earlier, the S&OP process in the case company was mainly the responsibility of S&OP Manager and because of that the commitment from the other parties was not sufficient. Now, authority has been distributed more equally between the process participants, which can be seen from the RASCI model (Appendix B). Despite the good distribution of authority, there can still be identified some variation in the motivation and commitment to the process between different functions.

Having continuous and standardized process helps in the collaboration between the different functions. People adapt and learn the process practices faster when the process runs frequently in set intervals and in standardized form.

Good communications channels are in the core of the success of cross-functionality. The cross-functional meetings held as part of the S&OP process in the case company are major facilitator of the collaboration between different functions. The meetings enable the sharing of diverse views and open discussion.

Another example of good communication in the case company is the sharing of information. The outcome of the process is always communicated widely to the parties



affected by the output. Hence, also the indirect stakeholders are kept well informed, which is seen as a vital thing based on the interviews conducted. In addition to the activities directly related to the S&OP process, many of the functions have daily communication with each other and people also know each other well, which facilitates the collaboration enormously. According to the interviews with the representatives from sales, the most important thing related to cross-functionality is to ensure seamless communication and trust between sales and supply. The process related trainings are also conducted to both direct and indirect stakeholders to raise awareness of the process itself, process procedures and factors affecting the decision-making.

To summarize the findings related to cross-functionality, it can be said that in order to create a well-functioning cross-functional team, the case company has established clearly defined roles and responsibilities within the process with the help of RASCI model. This also helps in the assignment of authority within the stakeholders. There are good practices in place related to the communication within the process, which is a prerequisite for successful cross-functional collaboration. All these findings are also highlighted in the MTS S&OP process guidelines. Hence, it can be said that cross-functionality is required in both cases. The biggest difference with MTS S&OP process is that the case company is not having integration with suppliers and customers when it comes to the S&OP process. This can be explained by the fact that both the supplier and customer base of the case company is complex and wide, which makes it difficult to integrate it as part of the process. In addition, no direct value added is seen from this integration since there are already stakeholders from sales, sourcing and procurement participating in the process who are expected to also represent the views of the customers and suppliers.

#### **4.4.3 Roles and Responsibilities**

According to the observation conducted, the stakeholders of the S&OP process in the case company can be divided into direct and indirect actors. The direct actors are directly involved in the process activities by attending the meetings or preparing material for them while the indirect actors are being affected strongly by the output of the process in their daily work but do not themselves participate in the process activities.

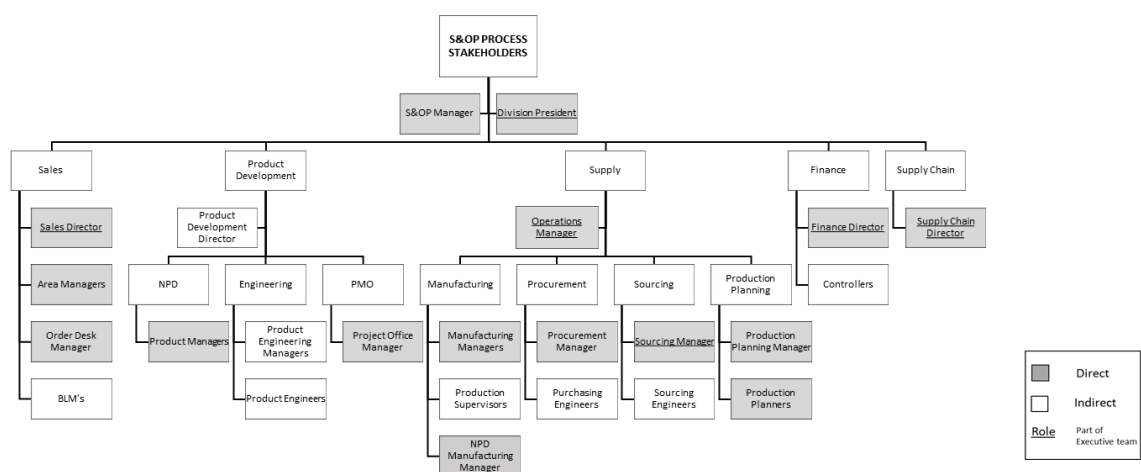
The direct actors of the process can be further divided into different functions according to their role in the organization. The functions that participate in the S&OP process activities are sales, new product development (NPD), project management office (PMO), supply, finance and supply chain. Supply function can be further divided into manufacturing, procurement, sourcing and production planning. Under these functions

there are variable number of roles participating in the process. In addition to these, there is S&OP Manager who is responsible of the coordination of the whole process and the division president who attends the executive meeting. Notable is that the case company does not have own function for S&OP. This means that the person being responsible of the S&OP process coordination is also the production planning manager and, hence, cannot focus just on running the S&OP.

The group of indirect actors is much larger than the one of direct actors. The indirect actors basically consist of the same S&OP functions as the direct actors, but the roles vary. For example, from the manufacturing the manufacturing managers are direct actors, but the production supervisors are indirect.

The process stakeholder mapping presents both direct and indirect roles involved in the S&OP process (Figure 8). The direct roles are marked in grey and the members of the executive team are underlined.

In his interview, Supply Chain Director explained what the role of the executive team in the process is. According to him, the executives have the accountability of the whole process. They are responsible of creating discipline and routine and making sure that there are enough resources to run the process. Since they do not have enough time to be involved in the technical execution of the process, they have to generate and allocate resources to make it happen. During the process execution, the role of the executive team is to make the final decision on the volume and product mix and authorize further actions in the executive meeting.



**Figure 8.** Process stakeholder mapping.

To help to define the roles and responsibilities in the S&OP process, the company uses RASCI model. The model indicates the responsible (R), accountable (A), supportives (S), consultatives (C) and informed (I) people for each process step. The person being responsible of the process step does the actual job related to the process step execution while the accountable person makes sure that the job gets done. Consultatives are the ones that need to be consulted on the decisions made in the process step in question while supportives can also provide their insight, but they do not need to be asked. Informed people need to be informed about the decisions made in the process step in question. The RASCI model for the case company's S&OP process can be found in Appendix B.

The main issue that the company is facing related to the process's roles and responsibilities is the fact that S&OP is not function as itself in the organization nor is there a role that is 100% dedicated to the process. This poses resource issues and, hence, can affect the quality of the process. In several interviews, it has been acknowledged that especially the demand planning phase of the process, the company would need more resources to further analyze and consolidate the sales forecast to enhance the quality of the process input. There has been discussion on creating a role for Demand Planner who would be responsible of the above-mentioned tasks and take some preparation work away from the S&OP Manager.

The main findings related to the roles and responsibilities within the S&OP process are that there are both indirect and direct stakeholders involved, and both of these groups should be taken into account in the process execution. The group of direct stakeholders include representatives from sales, NPD, PMO, manufacturing, procurement, sourcing, production planning, finance and supply chain. In addition, there is also the executive team, which is also cross-functional.

When comparing the case company's S&OP process with the S&OP process in MTS environment, it can be noticed that marketing and IT are missing from the representatives of the case company's process as well as a role that is 100% dedicated to the coordination of the process. Related to the latter difference is also the fact that in the case company, the S&OP is not accepted as its own function. These differences cannot be explained by the nature of the business environment but rather by the resource limitations of the case company and this is something that should be considered inside the company. Hence, no major differences are seen between the S&OP processes in MTS and ETO environment regarding roles and responsibilities.

## **4.5 Enablers of Sales and Operations Planning**

The enablers of S&OP consist of tools and data, performance management and S&OP culture and leadership. All of these include features or characteristics that facilitate or improve the performance of the execution of S&OP and, hence, are an important part of a successful S&OP.

### **4.5.1 Tools and Data**

Based on the observation conducted, the software and tools that are used to support the execution of the S&OP process in the case company include excel spreadsheets, Power BI-reports, CRM based tool and reports, ERP based scenario analysis tool, Integrated Management System (IMS) and SharePoint. In addition, ERP based S&OP system is currently in the planning phase.

Excel spreadsheets are used to in the building of demand plan during demand review - meeting and also in visualizing the changes between current plan and the demand plan. Excel is found to be most suitable tool currently for the above-mentioned tasks since, it is the only existing tool that allows quick manual modifications to the plan and the changes are also visualized automatically on the same spreadsheet. However, the Demand Plan excel requires manual preparation, since the current production plan needs to be copied to the spreadsheet to be used as a base for the demand plan. Hence, more automatized solutions are being wished for.

Power BI-reports are used in multiple different steps during the S&OP process. The benefits of using Power BI-reports include the fact that they are automatically updated, can be viewed from both computer or mobile devices, can be shared easily with the relevant audience, enable forming of customized dashboards to gather and visualize the most important information on one page. The case company uses Power BI -reports in the S&OP process to view the sales forecast, current production plan, order intake and order backlog development, forecasting accuracy and to follow the development of production plan. According to several interviews, the Power BI-reports have been seen as valuable tools that facilitate and decrease the preparation time needed prior the meetings.

In the company's CRM, there is a sales forecasting tool, which is used by Area Managers to fill the sales forecast. The forecast is updated manually but the tool automatically generates a sales forecast report based on the figures submitted. According to the interview with Area Manager, the forecasting tool is not performing on the level wished for which decreases the motivation of Area Managers in fulfilling the tasks required by

them. Hence, it can be said that functional and user-friendly tools are a prerequisite to have committed and motivated stakeholders.

The ERP based scenario analysis tool is used to evaluate the given scenarios regarding production load and capacity and staff requirements. Currently, the tool is not working as wished for. It provides outlook on the future workload versus capacity, but according to Production Planner it is difficult to use and in some cases it is also unreliable.

In Integrated Management System (IMS), the overall S&OP process is documented. The documentation includes a visual process chart and responsibility assignment matrix (RASCI model) as well as detailed instructions for each process step. The documentation is used as a training material for the process stakeholders.

SharePoint is used to distribute and store all the files related to the process execution including the monthly S&OP pp-presentation, annual S&OP calendar, demand plans and Master Plans. All the direct stakeholders of the process have access to the S&OP SharePoint.

After observing the performance of the S&OP process it could be seen that the biggest challenges that the case company has acknowledged related to the tools and data management are the storing and reviewing of history data, conducting scenario analysis and fully automizing the reporting and performance measurement. In addition, the data format between different IT-systems and between different functions varies a lot, which remarkably slows down the integration of different plans and data. To solve some of these issues, the case company is considering the implementation of new S&OP system that would possibly reduce the manual work needed to run the process.

When comparing the tools used in the case company's S&OP process with the guidelines for MTS environment, a lot of similarities can be found. In both cases the use of dashboards and automatic reports is highlighted. In addition, it is essential to be able to conduct scenario analysis. Scenario analysis can be considered even more important in ETO environment where the demand fluctuations and difficulty to forecast are present. This can also be seen from the fact that the case company has a separate process step for selecting the scenarios. Otherwise, the requirements for tools and data in S&OP for both MTS and ETO environment are considered equal.

#### **4.5.2 Performance Management**

The performance management in the case company can be divided into the metrics reviewed during the process execution and the process documentation.

The metrics presented in Table 5 represent the metrics that are reviewed and monitored during every S&OP process round. In addition to these, other metrics can also be viewed varying from month to month depending on the current hot topics and areas of interest. However, in the case company it has been seen important to have some constant metrics to be monitored from month to month to be able to see the development of the markets and operations.

The metrics have been divided based on the responsibility area of the metric. The areas are sales, supply, finance and S&OP. The metrics of sales are mostly concerned on showcasing the demand outlook and the case company's ability to forecast the demand. Supply's metrics are focused on capacity measurement and production performance in general and S&OP is responsible of metrics related to the performance measurement of the process itself. Measuring the performance of the process has been seen important in the case company since it is essential to be able to show how does the process provides value to the company's business and why should resources be allocated to the process.

According to several interviews, including the one with Finance Director, one big issue related to performance management in the case company is currently the lack of proper financial metrics from the S&OP point of view. In more detail, the lack of ability to reflect the effects of the different decisions on the financial ratios of the company. Especially, the effect on NWC is highlighted. This challenge has been acknowledged and it is being investigated how the finance could be better involved in the scenario analysis. This would enormously help the executives in the decision-making since in the end, it is the financial metrics that matter.

Another issue is raised in the interviews with the representatives of supply. Since the product portfolio of the company is very wide and demand fluctuations are big, the production needs to be flexible and quickly adapt to changes in the business environment. Hence, some kind of metric to measure the flexibility ability of the production is seen beneficial.

**Table 5. Metrics reviewed in the S&OP process.**

<b>FUNCTION</b>	<b>METRICS</b>
SALES	External order intake (SEK)
	Factory order intake (pcs)
	Order backlog
	Finished goods stock
	Forecasting accuracy
	Leadtime inquiries
	Average lead time
SUPPLY	Component stock forecast
	Production load
	On time delivery
FINANCE	Financial forecast vs Master Plan
S&OP	Master Plan accuracy

The documentation related to the S&OP process in the case company can be found in Integrated Management System (IMS) and S&OP SharePoint. IMS includes the formal documentation of the process like process chart, RASCI model and detailed descriptions and instructions for the process steps. The S&OP SharePoint includes more practical documents related to the process execution i.e. S&OP calendar, monthly S&OP presentations, demand plans, Master Plans and training materials. All the direct stakeholders of the process have access to the S&OP SharePoint. It is highlighted by one of the interviewees that the calendar of the process needs to be available to all who are interested since it is vital to understand the cycles and dates in which the decisions are made.

The highlights related to performance management in the case company include having metrics that measure the performance across all the functions involved in the S&OP process and having clear documentation and process instructions available for all the relevant stakeholders. The same points are emphasized in the MTS S&OP process guidelines. Hence, it can be said that the requirements related to performance management in S&OP in both MTS and ETO environment are the same.

### **4.5.3 Culture and Leadership**

Based on the observation and interviews conducted about the culture and leadership regarding the S&OP process in the case company, the topics covered could be grouped into four distinctive areas: senior management support, stakeholder commitment, stakeholder trainings and process development.

From the discussion and observation, it is evident that the process is seen as a vital source of value for the company by many of the executives. This is seen from the facts

that the attendance rates of the executives are high in the meetings, resources are being allocated for the process development, the executives are involved in the process development and are interested in offering guidance and support in the process execution. In addition, the decisions made during the process are respected and their importance for the overall business is understood, which supports the statement that the process is receiving support from the top management.

However, it is not enough that the executives understand the value of the process. It is important also that the rest of the stakeholders are committed and motivated to perform the tasks expected from them. In several interviews, it was mentioned that a lack of motivation from some of the key stakeholders is detected, which clearly effects on the quality their input to the process. It was especially highlighted in the interviews that better attendance rate needs to be required and more authority needs to be assigned between the direct process stakeholders. The lack of commitment and motivation can be seen from signs like not attending the meetings or preparing poorly for the meetings. It can be a result of poor or unclear instructions, poor assignment of roles and responsibilities or poorly functioning systems and tools.

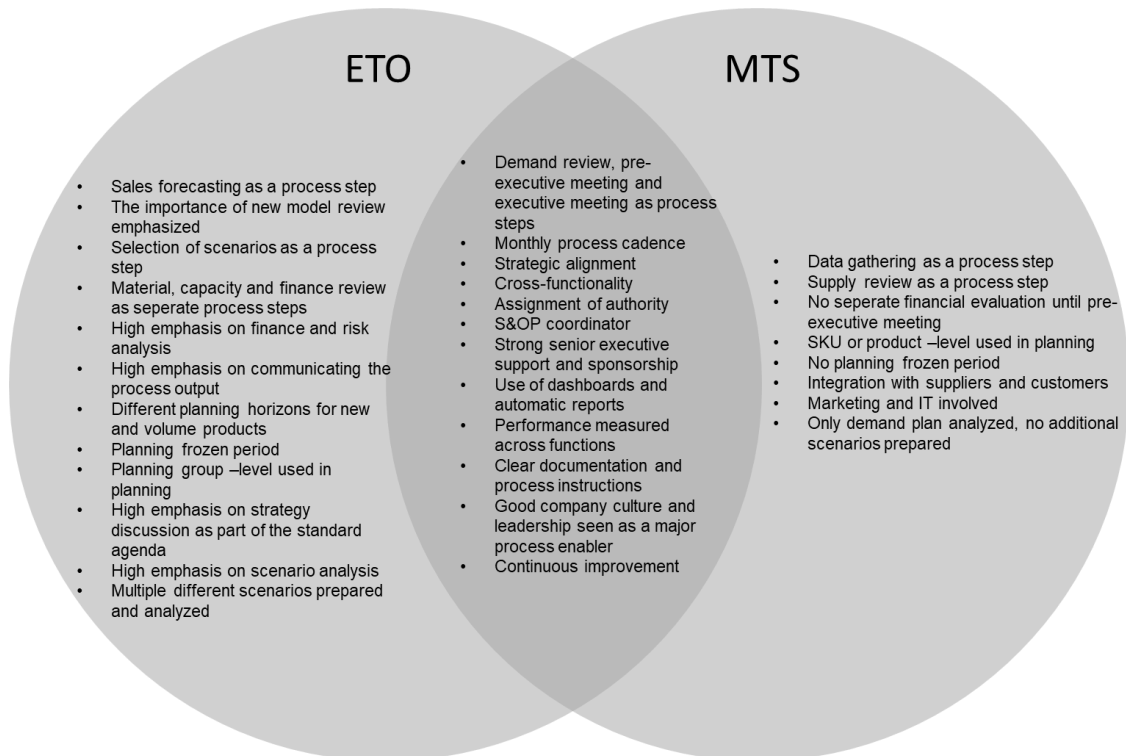
This problem has been acknowledged in the company and stakeholder trainings are being arranged to clarify and solve any process related confusion. In addition, resources have been assigned to define and develop the process. Both the trainings and the process development in general are signs of positive attitude towards the process, which serves as a good foundation to develop the process and the culture around it further.

When comparing the guidelines related to culture and leadership for S&OP in MTS environment with the case company's process, it is evident that the same things are considered important in both cases. Overall, good company culture and leadership around the process is seen as an essential enabler of the process since it plays a vital part in people management, which is in the core of S&OP due to its cross-functional nature.

#### **4.6 Summary of the Comparison Between the Sales and Operations Planning Processes in Engineer-to-Order and Make-to-Stock Environments**

When studying the findings of the empirical part of the thesis, it could be noticed that there could be found both similarities and differences between the S&OP processes in ETO and MTS environment. These similarities and differences are elaborated after each topic earlier in this chapter and are summarized in Figure 9.





**Figure 9.** Summary of the differences and similarities between the S&OP processes and practices in ETO and MTS environment.

Altogether ten exclusive characteristics of S&OP in ETO environment are identified together with twelve similarities with the S&OP in MTS environment. To enhance the understanding of where these differences stem from, a matrix analysis was conducted. The goal was to identify which of the key characteristics of the operating environment of the case company have led to the emergence of each of the differences. Summary of the analysis can be found in Table 6.

**Table 6.** The relationship between the characteristics of the case company's business environment and the S&OP process differences identified compared to MTS environment.

Differences	Globally spread demand	Fluctuating demand	Difficulty to forecast	Wide and complex product portfolio	High nr. of new products	High level of customization	Long material lead times	Long assembly lead times
Sales forecasting as a process step	x	x	x					
The importance of new model review emphasized				x	x		x	x
Selection of scenarios as a process step		x	x	x				
Material, capacity and finance review as separate process steps		x	x				x	x
High emphasis on finance and risk analysis		x	x				x	x
High emphasis on communicating the process output	x	x	x					
Different planning horizons for new and volume products		x	x	x	x		x	x
Planning frozen period						x	x	x
Planning group -level used in planning				x		x		
High emphasis on strategy discussion as part of the standard agenda	x	x	x	x				
High emphasis on scenario analysis		x	x	x				
Multiple different scenarios prepared and analyzed		x	x	x				

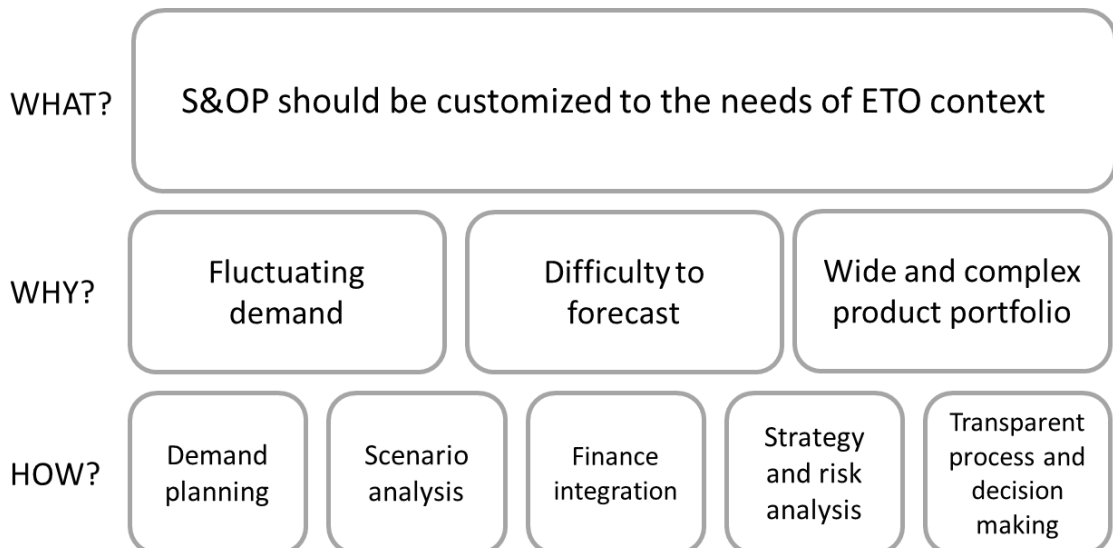
From the table, it can be seen that all of the business environment characteristics are behind at least one of the differences identified. This refers to the fact that the business environment that the company operates in clearly affects the way S&OP should be managed. The characteristics that got the most hits, hence can be referred to as the most significant characteristics when it comes to their effect on the execution of S&OP, are fluctuating demand, difficulty to forecast and wide and complex product portfolio. Two out of these three characteristics are related to demand management, which proves that demand is a major driver for the whole S&OP process.

In addition, it can be seen that all of the differences have multiple business environment characteristics affecting on their existence. Thus, each of the differences supports the fulfillment of the requirements of multiple business environment characteristics. All in all, the S&OP characteristics that are exclusive for ETO context take into account all of the business environment specific requirements, hence the process is well optimized for ETO environment.

## 5. DISCUSSION

The goal of this thesis was to develop an execution framework for sales and operations planning in Engineer-to-Order environment to better consider the business environment specific characteristics in the process execution. This chapter presents the framework, which was constructed as a result of the findings presented in the previous chapter.

The findings of this research are summarized in Figure 10 and are further discussed in this chapter in relation to earlier research and existing theory. Thus, first the constructed framework is presented. After this, the biggest drivers affecting the need to customize the S&OP in ETO context are discussed. Finally, the unique factors of S&OP in ETO environment are examined.



**Figure 10.** Summarizing the key findings of this research.

In addition to discussing the key findings of the research, the execution and results of weak market test is explained and recommendations for the case company are presented.

### 5.1 Execution Framework for Sales and Operations Planning in Engineer-to-Order Environment

The framework presented in Figure 11 and in Table 7 aims at offering guidance for carrying out S&OP in setting with characteristics of ETO environment. It is constructed based on the initial framework (Figure 5 and Table 4) created on the grounds of theory in Chapter 3, which focuses on S&OP in MTS environment. The final construction takes

into account the empirical findings of this research, which are used to supplement the theory.

The developed framework is divided into two parts: S&OP process structure (Figure 11) and S&OP best practices (Table 7). The first part of the framework presents the S&OP process structure as a whole with goals, inputs, outputs and key roles for each of the process steps. In turn, the S&OP best practices showcase the different organizational, technical and management related best practices that enable a successful S&OP in the organizations.

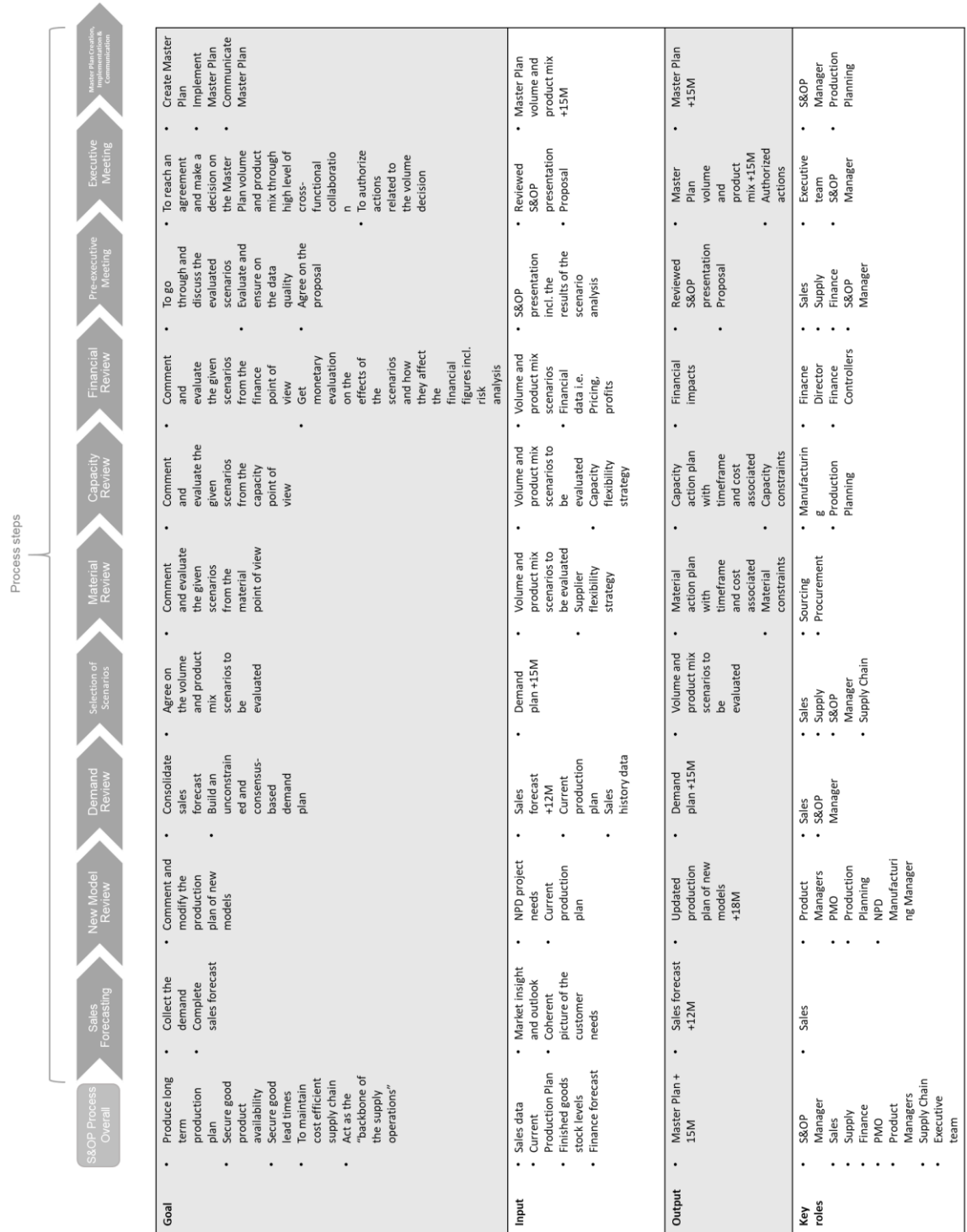


Figure 11. S&OP process structure in ETO environment.

**Table 7. S&OP best practices in ETO environment.**

Area of focus	Best practices
Planning parameters	<ul style="list-style-type: none"> <li>- Planning horizon <ul style="list-style-type: none"> <li>• 6-15 months, volume products</li> <li>• 6-18 months, proto and ramp up products</li> </ul> </li> <li>- 0-6 month frozen period</li> <li>- Volume and mix planning on planning group level</li> <li>- Process has monthly cadence</li> <li>- One process round lasts for two weeks</li> <li>- S&amp;OP process calendar published long beforehand</li> </ul>
Strategic alignment	<ul style="list-style-type: none"> <li>- Strategic guidelines driven from top-down</li> <li>- Strategy discussion as part of the standard agenda of the executive meeting</li> <li>- Process is led and supported by an executive team</li> </ul>
Cross-functionality	<ul style="list-style-type: none"> <li>- Process executed with a cross-functional team</li> <li>- Clearly defined process with defined roles and responsibilities</li> <li>- Assigned authority across functions</li> <li>- Continuous process</li> <li>- Good communication channels</li> </ul>
Roles & responsibilities	<ul style="list-style-type: none"> <li>- Both indirect and direct stakeholders involved</li> <li>- S&amp;OP team consists of representatives from sales, NPD, PMO, manufacturing, procurement, sourcing, production planning, finance and supply chain</li> <li>- Strong support and sponsorship by the executive team</li> </ul>
Tools & data	<ul style="list-style-type: none"> <li>- Automatic and real-time reports</li> <li>- Sales forecasting tool</li> <li>- Scenario analysis tool</li> <li>- Collaborative platforms to share and store documents</li> </ul>
Performance management	<ul style="list-style-type: none"> <li>- Metrics for both company and S&amp;OP performance</li> <li>- Metrics to measure performance across all the functions involved</li> <li>- Clear process documentation and instructions available for all the relevant stakeholders</li> </ul>
S&OP culture & leadership	<ul style="list-style-type: none"> <li>- Senior management support</li> <li>- Stakeholder commitment</li> <li>- Trainings for the process stakeholders</li> <li>- Continuous improvement</li> </ul>

Based on the comparison between the frameworks of ETO and MTS environments, it can be said that the biggest differences are related to the process structure while a lot of similarities can be found in the best practices. In other words, same functions are involved, same tools are used, and similar leadership is expected regardless of the environment. Nonetheless, the emphasis of these process enablers can be different in different environments. For example, the strategy aspect and scenario analysis are emphasized in ETO environment due to the demand volatility and complex product portfolio.

While the process enablers remain similar regardless of the operating environment, the way the process is organized clearly depends on the operating environment. This refers to the fact that the process steps vary depending on the operating environment. There are multiple process steps present in the S&OP process in ETO environment that cannot be found in the process structure in MTS environment. These process steps include selection of scenarios, new model review, material review, capacity review and finance review. Hence, it can be generalized that the process enablers do not depend on the

operating environment as much as the process structure and that in ETO environment the process structure is more detailed than in MTS environment. These findings imply that S&OP should be managed differently in different business environments and that the process needs to be customized based on the business environment specific needs.

According to Hicks et al. (2001), ETO supply chains have three major aspects that require coordination. These are sales and marketing, engineering and production. In addition, the strategies that are proposed to improve performance in ETO context include supply chain integration, information management, flexibility and improvements in NPD process (Gosling & Naim, 2009). Since S&OP is a common effort between the above-mentioned functions and has a big role in driving cross-functionality, information management and strategical alignment throughout the organization, the execution of S&OP process in companies operating in ETO environment is justifiable, which supports the importance of the framework created in this thesis.

In addition, Mello et al. (2015) and Hicks et al. (2001) argue that the competitive advantage emerges from the ability to successfully coordinate the internal and external processes and that the characteristics of the ETO context itself pose the need for creating unique coordination mechanisms, which is in line with the argument of this thesis that S&OP should be customized according to the business environment specific needs of ETO context.

## **5.2 The Biggest Drivers for the Differentiation of Sales and Operations Planning in Engineer-to-Order Context**

Based on the empirical results of this study, it was identified that all of the business environment characteristics drive the need to differentiate regarding S&OP in ETO context. However, the three biggest drivers are argued to be fluctuating demand, difficulty to forecast and wide and complex product portfolio.

Fluctuating demand forces the company to place high emphasis on close customer collaboration, which in turn requires a lot of resources to be placed in frontline operations. In addition, trends and weak signals need to be studied in order to understand the development of the demand. Getting a coherent picture of the demand globally is essential as is the ability to be flexible in responding to the demand fluctuations. According to Minguez et al. (2011), agility is one of the top priorities for ETO companies in order to react to changing market needs. This can be considered as the reason why the findings of this thesis suggest that understanding the demand and future as well as reacting fast to the changes in the markets is in the core of S&OP especially in ETO context.

The difficulty to forecast in ETO environment forces the S&OP process to place a high emphasis on sales forecasting, since the quality of the sales forecast, the main input of the process, needs to be ensured. The findings of this study propose that one way to do this is to assign more authority to people carrying out the forecasting to ensure that they take the responsibility of the numbers they submit. To support this, forecast accuracy needs to be measured. Wallace & Stahl (2008) claim that same forecasting methods cannot be used in MTS and ETO environment. Based on the statement by Wallace & Stahl (2008), it can be argued that, since forecasting and demand planning is a crucial part in the S&OP process, the S&PO processes in MTS and ETO environment cannot be similar. Hence, forecasting drives the need to differentiate the processes.

Based on the findings of this research, complex product portfolio is seen as one of the three biggest drivers to S&OP differentiation between different business environments. In S&OP process execution in ETO context this has resulted in simplified planning by using planning groups rather than product models, differentiating the demand planning of standard and new models as well as placing special emphasis on comprehensive analysis of the different scenarios in the form of material, capacity and finance reviews.

To summarize, all of the identified drivers create a lot of uncertainty for the organizations operating in ETO environment, which encourages them to place emphasis on the execution of S&OP. With the help of a successful S&OP customized to the needs of the operating context the organization is able to react fast to the changing environment.

### **5.3 The Unique Characteristics of Sales and Operations Planning in Engineer-to-Order Context**

From the discussion above, it was evident that S&OP should be managed differently in MTS and ETO environments and multiple factors have been identified that drive the need to differentiate. Due to these drivers, the elements that characterize the execution of S&OP in ETO context are:

- Demand planning
- Scenario analysis
- Strategy and risk analysis
- Finance integrated as part of the process
- Transparent process and decision-making

The importance of demand planning is reflected from the fact that sales forecasting, new model review and selection scenarios are considered as separate process steps in



S&OP process. Hence, it can be argued that a lot of effort and resources are put in demand planning in the hope of getting as realistic and accurate picture of the demand as possible. This is essential since the S&OP process is demand driven and, if the quality of the input is poor, so is the quality of the decisions made as a result of the process. The main drivers for emphasizing demand planning in ETO environment are the highly variable and volatile and the difficulty to forecast demand together with the wide and complex product portfolio. However, Croxton et al. (2002) propose that in industries, where the demand variability is high, like the ETO environment, it might be more beneficial to focus on increasing the flexibility of the operations rather than the forecast accuracy. Based on the findings of this research, through S&OP the importance of both of these approaches are emphasized.

Preparing and analyzing multiple different scenarios during the S&OP process stems from the same factors as the high emphasis on demand planning: the need to address the challenging and unpredictable demand situations. In addition, the wide and complex product portfolio plays a part in this. Multiple different scenarios are selected and analyzed in order to minimize the errors in the demand plan and to give the executives more coherent picture of the different opportunities and possibilities on how to react to the demand situation at hand. Vollmann & Whybark (1997) agree that what-if analysis is one way to cope with the uncertainty that is present in ETO environment, which supports the finding of this research.

Again, because of the highly volatile markets and the difficulty to forecast, strategy and risk analysis has a big role in the S&OP in ETO environment. This is emphasized in the scenario analysis part where the scenarios should be evaluated by the risk level and the strategic intention as much as by the capacity and material implications. Risk taking belongs as part of the nature of the business in ETO environment because of the high uncertainty (Vaagen et al., 2017), which makes it important to be able to consciously evaluate the risks as well as track and document the risk decisions made. S&OP offers the possibility to do that. Based on previous research on the topic of risk management in ETO environment, it has been recognized that risk management is often not carried out well (Ferreira et al., 2018). This should encourage companies to see S&OP as a way to be more successful in risk identification and mitigation. In addition, Ferreira et al. (2018) emphasize the importance of identifying both internal and external risks, which is often forgotten and, hence, can lead to serious financial problems in ETO context.

Related to the risk analysis discussed above, the finance has a vital role in evaluating the risk, both positive and negative, in monetary value. This requires having finance function integrated as part of the S&OP process and focusing on finance perspective as

well as on demand and supply. Notable is that because of the time-consuming information gathering related to the complex supply chain in ETO environment, the focus and attention that the finance evaluation receives is often decreased. In other words, there is often a lot of time spent in supply planning during the S&OP but only a little effort given on finance evaluation even though the effects of the different scenarios should be transferred into effects on the financial figures of the company since that is what interests the decision makers. Hicks et al. (2007) states that due to the high capital commitment and, hence, high work in progress (WIP) costs that the products manufactured in ETO environment cause, measuring the performance in terms of total costs is at its utmost importance for ETO companies. Hence, finance integration is considered a challenging but, if succeeded to be implemented, a valuable effort in S&OP.

Transparent process and decision-making can be considered vital in S&OP in ETO context, which is supported by the following findings. First of all, there is a high emphasis on communicating the output of each process round to a wide audience. Secondly, there are company-wide trainings organized on the practices and mechanisms behind S&OP to increase the transparency of the process as well as the decision-making within the process. This is vital in order to increase the understanding of the factors that affect the decision-making and indicate the ways that the stakeholders are able to affect the decisions. Transparency is considered extremely important in ETO environment due to the complex nature of both the markets and supply chain, which often result in seemingly illogical decisions. If the factors contributing to the decision-making are not clearly communicated, it can cause confusion and lack of confidence towards the decision makers.

#### **5.4 Validating the Construction with Weak Market Test**

To validate the construction developed in this research, a weak market test was carried out. This was done by evaluating the construction developed as a result of this research regarding the extent and intensity of the usage in the case company. The first part of the construction, the S&OP process model, was presented in a meeting with the executive team where it was discussed and approved to be implemented. Hence, the S&OP process model has been implemented in the country organization of the case company and is being used in regular basis. At the same time, the former process model was replaced by the new construction.

The second part of the construction, the S&OP best practices, is being used in the country organization partly. In other words, most of the areas covered in the construction are being applied in regular basis while some are not. However, the areas that have not

yet been implemented are agreed by the managers of the case organization to be valuable and there is a willingness to implement them in the future. Hence, the weak market test is passed.

In addition to having the construction implemented in one country organization, it has also been presented to the other country organizations within the same business division where it has also been received positively. However, it has not yet been implemented in full extent. This positive acceptance reinforces the result of the weak market test.

To conclude, both parts of the construction have passed the weak market test. The S&OP process model has been implemented and is being used regularly. In addition, it has also been received positively in other parts of the divisions. The S&OP best practices have been implemented partly and there is a willingness to apply it in full extent.

## **5.5 Recommendations for the Case Company**

The result of this thesis, the execution framework, is a construction developed based on theory and empirical research. Based on the framework constructed, recommendations were created for the case company related to the execution of S&OP. The following actions are recommended:

- Continue development with finance integration
- Investigate the possibility of acquiring/developing better scenario analysis tool
- Allocate a new resource for demand planning
- Allocate 100% role for the S&OP Manager
- Enhance communication with the frontline
- Enhance strategic focus in the decision-making

The importance of having finance as a part of the S&OP process has been acknowledged in the case company. So far, finance role has been more or less in providing the finance forecast to be evaluated once a quarter and in challenging the decision makers in the executive meeting. However, no financial data or figures have been presented. There have been discussions on how the S&OP could benefit from finance integration and what would be the best way to integrate it as part of the monthly process. This development should be continued further to enable better quality of the scenario analysis and, therefore, better fundamentals for the decision makers.

The company has a scenario analysis tool but, according to the feedback from the production planners, it is not working on the level wished for. It is complicated to use, unreliable and can only evaluate the scenarios from the capacity point of view. Hence,

an investigation in finding a better scenario analysis tool, which could also analyze the material situation is recommended.

The case company is having difficulties in consolidating the sales forecast and in creating a coherent global view of the demand. This problem is stemming from the fact that there are not many roles responsible of the demand globally and, consequently, not enough resources to analyze the sales forecast on a global level. Since the sales forecast and demand plan serve as the most important inputs to the whole S&OP process, the quality must be good. Otherwise not much can be expected from the output of the process. Based on these arguments, a new resource is recommended being allocated to demand planning in the case organization.

Currently, there is no role in the organization that is 100% dedicated to the coordination of the S&OP process and this is naturally reflected in the effort that can be given to the process. To enable systematic coordination and development of the process a full resource needs to be allocated to the process.

A lot of emphasis is given on the communication of the output of the S&OP process at the end of each process round. However, only the backline of the organization is being kept in the loop. Since it is the frontline that provides the important input to the whole process in the form of a sales forecast, they would surely benefit in hearing about the decisions made and the reasons behind these decisions. Feedback could also increase their motivation towards the process.

Since the operating environment of the case company can be unpredictable and, hence, complicate the planning, having a clear strategy plays an important role in their business. It is recommended that strategy discussion should be brought as part of the standard agenda of the executive meeting together with risk analysis on the different scenarios analyzed. The decisions made should reflect the strategical intention of the company. This would help the alignment between strategy and operations, which is one of the main goals of S&OP.

Most of the above-mentioned recommendations are based on the assumptions there is will and dedication to develop the process further. However, if the current quality of the process and analysis conducted during the process are on good-enough level in the opinion of the decision makers, apparently more advanced process is not required. Hence, in the end, it is up to the executives to decide what is the amount of resources that is wanted being allocated to the process and it should be understood that this choice correlates directly on the quality of the decisions made.

## 6. CONCLUSION

This chapter concludes the main findings of this research by answering the research questions. The reliability and validity of the study are also assessed to ensure the credibility of the findings. In addition, direction for future research is presented.

### 6.1 Answering the Research Questions

The main objective of the thesis was to create and execution framework for sales and operations planning process in Engineer-to-Order environment. To reach this goal the following research questions were answered, and the main findings related to these are presented.

**RQ1.** How is sales and operations planning defined in Make-to-Stock environment and what are the best practices related to its execution in the academic literature?

The first research question was answered through a literature review in Chapter 3 and the findings were summarized into a framework presented in Figure 5Table 4. S&OP best practices in MTS environment. and Table 4.

In MTS environment, it was found common that the process is carried out in standard form monthly with 4-6 process steps. The process steps include data gathering, product management review, demand review, supply review, pre-executive meeting and executive meeting. Data gathering and product management review were not present in all of the processes studied.

Related to organizational aspect of S&OP in MTS environment, it was identified that strategic alignment, cross-functionality and clearly defined roles and responsibilities play a big part in having a successful process. The plans born as an outcome of the S&OP process should always be derived from the business and strategic objectives of the company. In addition, the process requires a cross-functional team where the authority has been assigned to all of the functions. S&OP team should consist of representatives from sales, marketing, demand planning, supply planning, finance, procurement and IT. On top of this, it is vital that the process has a strong executive support and sponsorship. Having a clear leader or coordinator for the process is also emphasized.

When it comes to the enablers of the process execution, tools and data, performance management and S&OP culture and leadership were discussed. Use of dashboards that bring together and visualize all the vital information related to the decision-making is

encouraged. The metrics and reports reviewed should be automatic, in real time and in format that is commonly agreed on. The metrics should also review performance and drive accountability across all the functions involved in the process. In addition, the process should be well documented with agendas and schedule of the meetings as well as with overall process description with roles and responsibilities assigned. Having top management support with excellent leadership capabilities is also emphasized since this plays a vital role in the commitment and motivation of the other process stakeholders. Other factor that has been seen to increase the trust in the process is the adherence to the decisions made as well as having continuous improvement regarding the process.

After getting a deep understanding of the S&OP process execution and process enablers in MTS environment, through empirical research with interviews and observation a corresponding process and practices were studied in the case company in ETO context. After which it was possible to investigate the answer to the second research question:

**RQ2.** What are the biggest similarities and differences between the sales and operations planning in Make-to-Stock and Engineer-to-Order environment?

The biggest similarities and differences between the two processes were identified through a comparison between the theory framework created in Chapter 3 and the results of the empirical part of the research. The summary of the findings was visualized in Figure 9.

The biggest similarities are related to the organization and enabling factors of the process. The common organizational factors include having strategic alignment, cross-functional team, assignment of authority across functions, clear process coordinator and executive support and sponsorship for the process. The common enabling factors, on the other hand, include having performance measured across functions, a clear process documentation and instructions and good company culture and leadership together with commitment to continuous improvement. In addition to these organizational and enabling factors, other similarities include the monthly cadence of the process and having demand review, pre-executive meeting and executive meeting as process steps.

The biggest differences identified are related to the S&OP process structure. In ETO environment, sales forecasting, new model review, selection of scenarios, material, capacity and finance review are seen as process step while none of these exist in MTS environment. On the other hand, data gathering and supply review are process steps that can only be found in MTS environment. Another significant difference is related to the planning horizons. In ETO environment, there is a planning frozen period used up until six months into the future and the span of planning horizon for S&OP depends on

the novelty of the product. Standard products have planning horizon of 6-15 months while proto and ramp up products have a horizon of 6-18 months. In MTS environment, there is only one planning horizon used. In addition, in MTS environment the planning is carried out in more detailed level than in ETO environment referring to the use of SKU or product-level in planning.

Besides having differences between the process structures, additional differences can also be identified. The importance of having emphasis on strategic discussion together with risk analysis and preparing and analyzing multiple scenarios are unique characteristics for ETO environment. Another notable distinction between the processes is the emphasis on finance review as part of the process. It was noticed that finance evaluation plays a bigger role in ETO environment.

By discovering the above-mentioned similarities and differences between the processes in two different business environments, it can be argued that S&OP should be customized according to the business environment specific requirements. This should be done in order to better respond to the needs surfacing from the business environment.

As a part of the answer to the second research question, the unique characteristics for sales and operations planning in ETO environment were identified. When analyzing the business environment of the case company and forming a matrix of the business environment specific characteristics with its unique attributes for sales and operations planning an answer to the third research question could be investigated.

**RQ3.** What are the factors that drive the need for customization of sales and operations planning in Engineer-to-Order environment?

The answer to the third research question is visualized as matrix in Table 6. Each of the business environment specific characteristics contribute to the existence of some of the unique attributes of S&OP in ETO context. However, the most influential factors are fluctuating demand, difficulty to forecast and wide and complex portfolio. From the S&OP point of view, these factors are considered critical since due to them the planning needs a lot more effort in the form of demand planning, scenario analysis and strategy and risk analysis. In addition, having finance integrated as part of the process is seen vital as well as having transparent process and decision-making practices.

## **6.2 Reliability and Validity**

To be able to evaluate the credibility of the findings of this research, reliability and validity need to be assessed. Together reliability and validity demonstrate the rigorousness and trustworthiness of the research (Morse et al., 2002). Reliability describes how well the

data gathering methods employed in the research are able to produce similar results regardless of who and when is the data collected (Kirk & Miller, 1986; Saunders et al., 2009, p. 326) In addition, reliability is seen as a way to describe how well the effects of random circumstances on the results have been able to be eliminated (Kirk & Miller, 1986).

According to Saunders et al. (2009, p. 156), participant error, participant bias, observer error and observer bias can be considered as threats to the reliability. Participant error is concerned on the factors that might affect the participant's behavior. For the interviews conducted in this study, the interview questions were tested with two different parties beforehand with the aim of excluding leading or otherwise poorly formed questions. The interviewees were informed about the subject of the interview beforehand, which enabled them to prepare for the interview. However, one interviewee had a bit different understanding of the topic of the interview, but this problem was overcome by the interviewer asking additional defining questions.

Participant bias is concerned on the fact that the interviewee is answering what he/she is expected to answer (Saunders et al., 2009, p. 156). In this study, the interviewees knew that the results were analyzed anonymously, and they were not recorded. In addition, the interviews were conducted in a closed meeting room. This enhances the trust between the interviewee and the interviewer, which increases the reliability.

Observer error means that the results may be different depending on who is the interviewer (Saunders et al., 2009, p. 157). The interviews in this study were not recorded but notes were taken. Because of this there is a possibility that the interviewer has missed some points that the interviewee is saying. Thus, some beneficial opportunities to ask additional questions may have been missed. However, the interviewees were aware that the interviewer was taking notes simultaneously and, hence, they kept pauses in their speech.

Observer bias, on the other hand, refers to the factors that might affect the researcher's ability to record the answers (Saunders et al., 2009, p. 157). Like mentioned earlier, the interviews held were not recorded, but notes were taken, which can increase the observer bias since some points could have been missed. However, in case of misunderstanding or need to get back to the interview answers afterwards, this could be done since the interviewer worked in the same organization and had daily collaboration with all the interviewees. In addition, observation and studying of secondary material from the case company was carried out, which were used to validate and supplement the interview results. This reduces the observer bias.



Furthermore, participation bias can occur too. This considers if some relevant participants were left out or if unsuitable participants were included in the research. The selection of the case organization can be considered successful since it was evident that they operate in ETO environment and have long experience in carrying S&OP in different forms. The people interviewed were selected based on their role in the S&OP process. People from every function were interviewed and all the interviewees had participated in the process execution for multiple years. Hence, their knowledge on the topic can be considered good. The selection of interviewees was successful, which decreases participation bias.

In addition to evaluating the reliability, one must also be sure about the validity of the research. Validity refers to the correctness of the results. It is essential to understand are the data gathering methods employed suitable for reaching the objectives of the research and do the results mean what they are argued to mean. (Saunders et al., 2009, p. 157) In case of qualitative research, the question of validity is heavily linked to the generalizability of the research (Saunders et al., 2009, p. 335).

Interviews conducted as part of the empirical part of this research can be considered as a threat to the generalizability due to the small sample size. The sample size of this research was eight people and they were all from the same organization. However, they all had different roles, which provided a broad perspective on the subject under study. If the sample size is considered as a threat to the reliability, the generalizability of the research can be enhanced by connecting the findings to existing theory and, hence, demonstrate that the results have theoretical significance (Saunders et al., 2009, p. 335).

In this research, there is a construction created of the execution of S&OP in ETO environment based on an empirical research on one case company and literature review on earlier academic research. Even though the construction was based on only one company, the fact that theory was used to support the framework construction, make the findings applicable to other ETO organizations besides the case company. In addition, Saunders (2009, p. 335) argues that if a single case study is conducted with a wide range of different people and that the activities are invariably studied, the study may encompass a number of settings. Thus, the findings of this research can be detached from the limitations of a specific organization. In addition, the results of this research can give reference to other industries executing S&OP even though the study was conducted in industrial manufacturing context. In order to further validate the results of this study, it can be conducted in different industry.

All in all, the reliability and validity of this research can be considered decent. The reliability could have been improved by recording the interviews and increasing the sample size. The overall generalizability of the research makes the validity sufficient considering the requirements of master's thesis.

### **6.3 Future Research Direction**

The scope of this thesis was to study the execution of S&OP in ETO environment on a local level. An interesting topic for further research would be on developing S&OP to serve all of the company's production units on global level. An understanding of the requirements and possibilities of a global S&OP would encourage companies operating in ETO environment to pursue the opportunity in the search of an increased performance.

Since a thorough practical testing of the framework created in this thesis was not possible in the timeframe provided, it is proposed that the effect of implementing the framework on the performance of companies should be studied.

Additional area of further research could be related to the comparison between the effort and quality of the output in the S&OP execution. Based on existing research as well as on the findings of this study, it is evident that the process of S&OP is heavy to carry out and requires a significant amount of resources from various functions in the organization. Therefore, it should be studied does the quality of the decisions made during the process and the final output of the process remarkably increase in relation with the resources put in the execution of the process. In other words, what is the optimal level of effort that should be given to the process execution. This would help companies to optimize their use of resources.

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# APPENDIX A: S&OP PROCESS, SWIM LANE DIAGRAM

