CHALMERS
UNIVERSITY OF TECHNOLOGY

Sales and Operation Execution

A study at SKF Group

Master of Science Thesis in the Supply Chain Management
Master's Programme

ADARSH MOHAN NULLIPADY
ELTON ASHOK RAJU

Department of Technology Management and Economics
Division of Supply and Operations Management
Chalmers University of Technology
Gothenburg, Sweden
Year of publication: 2020

REPORT NO. E2020:092

Sales and Operations Execution

A study at SKF

ADARSH MOHAN NULLIPADY
ELTON ASHOK RAJU

Department of Technology Management and Economics
Division of Supply and Operations Management
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2020

Sales and Operations Execution: A study at SKF
ADARSH MOHAN NULLIPADY and ELTON ASHOK RAJU

Master's Thesis E2020:092
Department of Technology Management and Economics
Division of Supply and Operations Management
Chalmers University of Technology
SE-412 96 Gothenburg, Sweden
Telephone: + 46 (0)31-772 1000

Chalmers Reproservice
Gothenburg, Sweden 2020

Sales and Operations Execution. A study at SKF
ADARSH MOHAN NULLIPADY AND ELTON ASHOK RAJU
Department of Technology Management and Economics
Chalmers University of Technology

Abstract

Sales and operations execution as a new business process concept has been rising dramatically to tackle volatile planning environments with high uncertainty. S&OE enables alignment of what was planned in the S&OP process to what is being executed. Although this subject has been talked about over the years as "weekly S&OP, short-term horizon, disaggregated plans and weekly frequency", the study on this topic is scarce. Hence, the primary goal of this thesis is to conduct exploratory research using a case study and contribute to literature the topic of S&OE.

This thesis was conducted as a case study at SKF, Gothenburg. SKF has successfully implemented the S&OE process in the US and Turkey markets without establishing the S&OP process and is continuing to expand the business process globally. SKF had initiated the S&OE process specifically to tackle the abnormal demand from the demand side of their supply chain. This provided an opportunity to examine the practical perspective of S&OE and explore the literature to what is nearly close to sales and operations execution. With this case study and using the abductive research methodology three research questions were formulated. RQ1 is defined to determine the general characteristics of S&OE from the research and compare it with SKF. RQ2 focuses on describing the workflow of S&OE at SKF and from a practical perspective dives into the roles and responsibilities of the main stakeholders of the process. RQ three defines if the S&OE process can be evaluated based on a maturity model considering the planning environment of SKF.

This thesis contributes literature on the topic of S&OE and aids SKF in evaluating their S&OE process. From the analysis it was concluded that the characteristics of S&OE are determined with a comparison from the case study to the literature. An S&OE maturity model was developed using the S&OP and S&OE literature gathered wherein an organization with the similar context as SKF can use this model to determine their present stance and look for future improvements.

Keywords: Sales and Operation Execution, S&OE, S&OE Maturity, Supply chain management, Industrial market, Demand control, Demand execution, Weekly S&OP, Maturity model

Acknowledgements

This master thesis was conducted at SKF Group Bearing Operation as a project during the period of January to June in the year 2020. This master thesis is a part of the master's degree program of Supply Chain Management at Chalmers University of Technology.

First and foremost, we would like to thank our supervisors at SKF, Matthias Pallhuber, Martina Zlatar and Ganesh Karekar, who was helpful in providing the right guidance and helpful advice through the research. We would also like to thank our colleagues Vignesh Mohan and Caroline Ostman at the department of Global planning and Demand management for sharing their knowledge and conversations that contributed to the project.

We also like to thank our supervisor Joakim Andersson and examiner Patrik Jonsson at Chalmers for supporting us all the way from the beginning of the thesis by giving necessary guidance and knowledge for driving the master thesis forward.

Adarsh Mohan Nullipady
Elton Ashok Raju

Gothenburg, Sweden, May 2020

Table of Contents

List of Figures

List of Tables

List of Abbreviations

Abbreviation	Full form
S&OE	Sales and Operations execution
S&OP	Sales and operations planning
MPS	Master production schedule
DP	Demand planning
PE	Planning environment
ML	Machine learning
AI	Artificial intelligence
MTS	Make to stock
MTO	Make to order
OTIF	One-time order in full
BPMN	Business process model and notation
WH	Warehouse
LWH	Local warehouse
FWH	Factory warehouse
RWH	Regional warehouse
IP	Integrate planning
CSR	Customer service representative
DMI	Demand management inquiry
SME	Subject matter experts
KPIs	Key Performance indicators

1 Introduction

In this chapter we present the background of the thesis and the company followed by the problem description as to why this master thesis was conducted. Research questions, aim, scope and delimitations of this thesis are also presented in this chapter.

1.1 Theoretical background

In the present business environment balancing demand and supply has become an essential problem to solve and obtain smooth operations in the company's supply chain. Primarily because the market is shifting from operational excellence to customer excellence. Increasing market volatility is compelling top executives in companies to deliberately look for various methods and processes in order to be flexible to demand variations, achieve cost and service benefits, reduce inventory and overall satisfy customers and increase profits (Chase & Chase, 2016). According to Grimson & Pyke (2007), sales and operation planning (S&OP) is one such process that synchronizes demand and supply in order to attain maximum profits.

The S&OP process initially began in the 1950s with aggregated production planning which then later evolved into manufacturing resource planning in the 1980s. It then later became well-known in the 90s as a process that supports more internal decisions of the firm. S&OP first came to academic works when it was referred to production planning by Ling & Goddard (1988). According to Gianesi (1998), S&OP is a process that connects manufacturing to top management and other functional areas of the company. Thus, aiming to balance demand and supply by collaborating plans with different supply chain departments within the company i.e. both vertically, from strategic to operational, and horizontally, between functional areas (Carvalho, 2018). The main role of S&OP is to facilitate the Master Production Schedule (MPS), Demand Planning (DP) and support in the connection between these two processes. In order to acquire this link between MPS and DP, the two main components of S&OP are the sales and the production plan must be synchronized. Sales plan is based on the demand forecast and the production plan ultimately provides the requirement of capacity needed, inventory level and order backlogs (Carvalho, 2018).

According to Lapide (2011), the business environments change drastically over time depending on global factors. Therefore, in order to balance the supply chain S&OP processes must best suit the context of the firm i.e. the S&OP process must help the firm conquer business difficulties such

as facing demand uncertainties, supply chain imbalance, profit, loss, etcetera and prevent any possible mishap. Ivert et al. (2015) contributes to this topic of designing S&OP process based on contextual factors. Ivert et al. (2015) uses the contingency theory to find planning environment (PE) variables that affect the S&OP processes. These PE variables requires more of agile planning with higher planning frequencies and shorter horizons and lower level of aggregated planning which puts out a requirement for weekly S&OP (Carvalho, 2018). These PEs could be high complexity environments, product complexity, long lead times, demand uncertainty, supply uncertainty, stock outs etcetera.

In addition, Pukkila (2016) states that plans made by top management were difficult to coordinate and execute since the S&OP process does not lend itself to an actionable plan but only to strategic plans. Hoey (2018) also highlights that there is no "established business function" which deals with "daily and weekly supply chain adjustments" which are required to maintain mid-to-long term plans. Therefore, agile planning has now become a recent highlight in the last two years where it is developing as a new process which aligns the tactical planning of S&OP to operations in volatile environments called Sales and Operations execution (S&OE) (Pukkila, 2016).

Shaikh (2018) discusses the importance of technology in the field of management and its evolution over the years which has tremendously impacted organizations positively in orchestrating the business process. Renowned organizations today are investing in advanced technology in order to provide solutions that are seamlessly coordinating their S&OP and S&OE process. New innovations such machine learning (ML) and Artificial intelligence (AI) facilitate a closed loop process by collecting and applying important data in a way that aids managers in recognizing disruptions earlier.

At present there is very limited academic works about S&OE, therefore throughout this paper literature will be used from specific papers written by Carvalho (2018) and Bower (2018) which discusses in depth about sales and operations execution and also, grey literature such as white papers from consulting groups, blogs, and articles published from Gartner and other sources will be used to build theoretical knowledge on S&OE. This master thesis is about establishing a stance theoretically on the topic of S&OE by exploring and analyzing the sales and operations execution on collaboration with a case company that is implementing this process globally.

1.2 Company background

1.2.1 History

This thesis is carried out at and in collaboration with SKF Group. SKF group is a Swedish bearing company that provides products and services within rolling bearing, seals, mechatronics, services, and lubrication systems. The company was founded in 1907 by Sven Wingqvist who had a patent on multi-row self-aligning radial ball bearings. The patent was granted to Sven Wingqvist on 6th June in Sweden along with other patents from ten different countries. The new ball bearing was very successful and by 1910 SKF had 325 employees and a subsidiary from the United Kingdom. With two years of establishment in Sweden by 1912 SKF had expanded globally to 32 countries and by 1930 SKF had employed 21000 people for 12 manufacturing sites worldwide, the largest manufacturing site located in Philadelphia.

In 1926, sales manager Assar Gabrielsson and managing director Björn Prytz of SKF founded the company Volvo AB. At the beginning, Volvo AB functioned as a subsidiary automobile company within the SKF group and it funded Volvo AB in the production of the first thousand cars which was built at Hisingen, Gothenburg. The ownership of Volvo lasted only till 1935 till the last shares were divested.

In the 1970s SKF undertook an enormous production development program in Europe. It was a visionary project called the "production concept of the 80s" which aimed to run production overnight without the laborers in order to increase productivity. To run production consistently and maintain the product quality an automatic flow of bearing was necessary, hence, SKF developed the flex link multi flex plastic chain conveyor system. SKF divested the flex link system as a separate entity in 1997. Since then, SKF has grown even more and holds a large market share in the production and distribution of bearings.

1.2.2 Current Businesses at SKF

Today, SKF is one among the largest manufacturers of bearings globally and currently it employs 43,360 people in approximately 103 manufacturing sites that are spread across 130 countries. SKF organization is split focusing on two markets i.e. Industrial as one and Automotive and Aerospace as the other.

With regard to the industrial market SKF supplies more than 40 industries worldwide with products and services, both directly and indirectly through a network of more than 7000 distributors. The product offerings include developing and manufacturing a wide range of bearings, seals, lubrication systems and providing services and solutions for the rotating shaft for

various applications across different industries. In the industrial sector SKF holds a leading position in certain industries such as railway and heavy industries, this position is also shared among other companies. The industrial sector is currently 72% of SKF's net sales with a market value of SEK 255-275 billion which also leads the position in the industrial distribution market serving products for the aftermarket industries.

Figure 1: *Angular contact ball bearing. Source: SKF(2020)*

With respect to the automotive and aerospace sector, SKF supplies customized bearing, seals, and related products for rotation of wheels, driveline, engine, e-powertrain, suspension and steering applications for automotive manufacturers such as cars, trucks, buses and two-wheelers. Few of the automotive manufacturers are Volvo, BMW, Rolls Royce, Formula One racing teams etcetera. SKF's position in this sector is also quite strong compared to their competitors. This company leads in the development of components for automotive electrification and the aftermarket industry for automotive. SKF holds a strong global position with its enormous distribution network containing more than 10,000 distributors. According to SKF Group (2019), it is recorded that 28% of SKF's net sales are from the automotive industry having a market value of SEK 145-155 billion. The competitors for SKF are also quite strong, just to name a few; they are; Schaeffler group, Timken, NSK, NTN, JTEKT, lljin, C&U and Wanxiang Qianchao. The Figure 1 presents a traditional ball bearing which is one of many other product variants that SKF produces. The Figure 2 below represents SKF's business coverage worldwide.

Figure 2: *SKF global representations of Business. Source: SKF*

As mentioned before the SKF organization is split into two markets: Industrial as one and automotive and aerospace as the other. In the automotive and aerospace sector S&OP process is used which is at a stage 4 maturity level in Gartner's S&OP model. Whereas in the industrial market the business process used is S&OE which is still at its infancy at the beginning of this thesis and has been implemented only in a few international markets. While the goal of S&OP for automotive and aerospace is profit optimization in the industrial sector the goal of S&OE is demand deviation handling process.

1.3 Problem Description

As mentioned before SKF has in place an S&OP process for the automotive & aerospace market and S&OE process for the industrial market. At the beginning, when SKF had initiated the implementation of an S&OP process for both markets only the automotive & aerospace market could progress and attain maturity whereas for the industrial market it had to be stopped and removed. The primary reason for this is, in the automotive industry there are only a few products on SKU level and the customers are able to give accurate demand schedules which helps SKF to obtain a smooth S&OP process. But, for the industrial market, there are a wide range of product portfolios distributed among a large customer base of end users who contribute to most of the customer's demand. Hence, due to the existence of large product portfolios distributed among diverse customers, abnormal demand from the customers forms a major issue from the demand side.

Since S&OP did not exist in the industrial market until the second quarter of 2020 due to various market uncertainties and organizational complexities, SKF began implementing an S&OE process in the final quarter of 2018. The S&OE process is an agile deviation handling process with a focus on identifying and controlling the inflow of abnormal demand into the SKF supply chain. At present, the organization has managed to implement the process of S&OE globally. The S&OE process at SKF has been internally developed and therefore requires an external evaluation. Hence, this thesis will focus on evaluating the process of S&OE implemented globally and studying various other business process concepts that is within the topic of demand management such as demand control and demand sensing that can be used to improve the current S&OE, and also determine if the roles and responsibilities are appropriately set.

1.4 Scope

The scope of the study is to evaluate the current setup of the S&OE process with a focus on evaluation of characteristics, roles and responsibilities and already set KPIs. In order to improve the current setup at SKF by giving a direction as to how their maturity can be improved and as a theoretical contribution towards S&OE process maturity, a maturity model is developed from the existing frameworks present in literature. Regarding the study, the thesis is conducted over 5 months within one focal company at the company headquarters in Gothenburg.

1.5 Aim

The aim of this thesis is to explore and evaluate the current S&OE process that is implemented at SKF Industrial markets and improve the capabilities of the S&OE process. In order to fulfill the aim, three research questions are to be answered as follows:

As mentioned before, there is a lack of academic work on the topic of S&OE. Hence, with the first research question stated below; it enables the authors of this paper to conduct an exploratory research among various journals, grey literature and consultant papers to obtain and establish literature on the topic of S&OE. With the literature in place, the S&OE process of the case company is analyzed.

Research question 1: *What are the characteristics of the S&OE process at SKF?*

At present, the case company is in need of an external evaluation of the S&OE process, with the second research question stated below and the literature established in this paper it enables the authors of this paper to examine the workflow and provide the necessary recommendation for suggestions and improvement in specific areas.

Research question 2: *How is SKF's S&OE process designed with respect to workflow and are the roles and responsibilities appropriately set for the process?*

In order to evaluate the maturity of the S&OE process of the case company, a maturity model must be used to determine its current state and provide suggestions on how the company can improve. With the third research question stated below it enables the authors to explore the maturity models available in academic works and select the nearly appropriate model from which it can be adapted in order to evaluate the S&OE process and provide recommendations.

Research question 3: *What are the contextual factors affecting the S&OE process at SKF and how can the maturity of the S&OE process be assessed.?*

The answer to the first research question proceeds by comparing SKF's S&OE characteristics to an S&OE model developed by Carvalho (2018). This comparison is done to find out how much of the practical characteristics of a business process such as S&OE is aligned to theory. For the second research questions, the workflow of the S&OE process and the role and responsibilities of stakeholders involved is reviewed with a focus on roles and responsibilities of Operational demand manger and the relevant KPIs. The answer to the third research question proceeds by analyzing the S&OP maturity model developed by Grimson & Pyke (2007) and identifying the similarities between S&OP and S&OE. A conceptual S&OE model is then developed by adapting from the S&OP maturity model. This model will be used to determine SKF's S&OE maturity.

1.6 Delimitations

This section explains the delimitations which were considered during the study i.e. the choices made by the authors to set the boundaries for the study.

This thesis is done purely on a qualitative basis with data collected through primary and secondary data sources. There is no consideration given to the analysis ERP systems used for the S&OE process as there is no quantitative analysis done.

This thesis was performed during a period of 6 months. Due to this time restriction it was decided to adapt the S&OE maturity framework instead of developing a maturity model and testing it which would require approximately a years' time or more. This research does not go in depth on factors affecting sustainability due to the time restriction on theory exploration and analysis related to sustainability. For instance, the sustainability aspect is briefly described in the recommendation section of "inclusion of supply side" where impact of reduced transport expedites on sustainability is explained. This is since the time to invest in depth on the sustainability part of the thesis was limited due to time restrictions.

Also, due to the unfortunate pandemic of COVID 19, there were difficulties getting the interviews from the stakeholders such as sales/demand managers which hindered the assessment of roles and responsibilities of other stakeholders involved in the S&OE process. Mainly, the company was in a survival mode where many planned interviewees had to prioritize their tasks instead of participating in the interviews of this thesis work.

During the halfway phase of this research, the S&OP process were implemented which was not included as majority of data collection for research were finalized. For instance, the company had lacked maturity in some aspects of demand planning which was analyzed in the beginning of research. Based on this analysis, demand planning maturity assessment was done to improve the

input to S&OE process. But later SKF had decided to take advantage of the pandemic of covid-19 to implement the S&OP process. Hence, S&OP which is in its infancy at SKF is not considered to be part of this research. Also, for the development of the maturity model it was considered not to include S&OP which is explained in first two stages of the S&OE maturity model.

Lastly, there was also an organizational change which was not considered under this scope of this thesis. But one aspect of the organization changes which is considered is the change of department of “Demand chain and Logistics” to “Global planning and Demand management”. One aspect which is ignored is the organization structure as to how the Automotive and Aerospace and Industrial market changed after SKF underwent the reorganization.

With respect to data collection, most of primary data was collected in a virtual environment. i.e. using the organization’s communication tool of “Microsoft teams”. In an online interview, although there is access to technology and good communication capability, the subtle visual non-verbal clues which aids to contextualize the interviewee in a face-to-face scenario are lost. Also, the participation in virtual interviews requires a higher level of motivation than compared to the conventional interview which is conducted face to face.

2 Theoretical Framework

This chapter explains the literature on the area of study. The aim of this chapter is to set a theoretical foundation in order to analyze the case company from the empirical finding in chapter four. The first section covers the planning hierarchy used in the business process of S&OP and S&OE and the following sections provide a detailed description of both the business processes. Thereafter, literature on the relation of other business processes and concepts are reviewed such as BPMN model, contingency theory, demand planning maturity and the RACI matrix.

2.2 Levels of planning hierarchy

Lapide (2011) discusses the three levels of planning that is essential for any business to be successful. The definition of a plan is "A plan should be a realistic view of the expectations" (Lapide, 2011, p.19). Based on the organization's goals and objectives a plan can be long, intermediate, or short range. It primarily depends on the framework within which the plan must be operated.

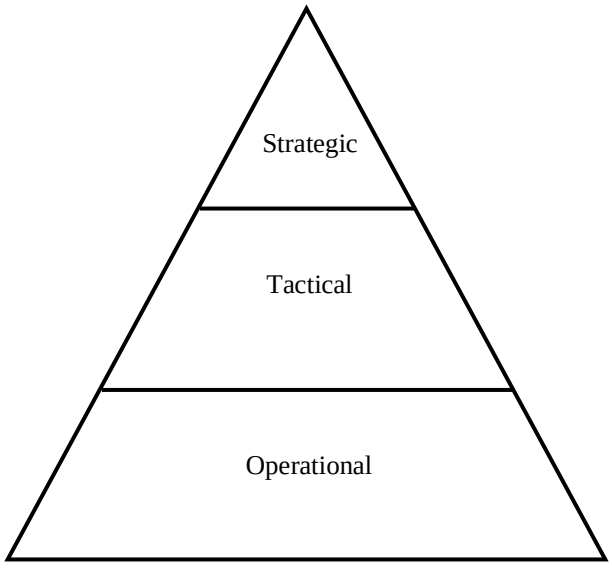


Figure 3: *Anthony's Hierarchical Control. Source: Anthony (1965)*

The three levels of planning as discussed by Lapide (2011) is strategic, tactical and operational planning. Strategic planning addresses how the organization proceeds to achieve its goals. It deals with developing resources and policies in a way that is aligned for obtaining organizational goals; for instance, a strategic plan can be generating new products, establishing factories in new locations, building a distribution network and so on. The overall perspective of the strategic plan

should be very broad which is based on a longer horizon along with decisions made by executives of the organization (Jonsson & Mattsson, 2009).

Tactical planning addresses on how the capacity or resources should be utilized for achieving the strategic plan for e.g., setting up production machines and man hour required to produce a certain product. The tactical plan should have a medium range planning horizon with items aggregated into product families (Jonsson & Mattsson, 2009). Tactical plans can also be updated based on whether it is achieving the strategic goals in an efficient manner.

Operational planning is activities that are on a done daily basis. The plans generated in tactical planning are disaggregated for daily activities. These plans are worked over a short planning horizon with lower management involved in managing and executing these activities. Carvalho (2018) presents a general structure of planning hierarchy by using Anthony (1965) which is presented in Figure 3. By using the planning structure presented in Figure 3, it is important to clearly distinguish where S&OP and S&OE can be placed in the hierarchy. This is done in consideration to avoid skepticism of understanding the aim of each process by looking into how far the plan is stretched out and what each process aims to achieve. In the later sections of this literature review Anthony's hierarchical control structure will be used to present where S&OP and S&OE is currently placed.

2.3 Sales and operations planning

Sales and operations planning (S&OP) is a process that has been implemented in companies worldwide. The definition of S&OP varies among different authors, but, according to Jonsson & Mattsson (2009), S&OP is a process that occurs at the top management level of a business organization which involves in creating and establishing plans for sales and production. The purpose of S&OP is to align cross-functional business decisions, goals and objectives that aim to balance out supply and demand from month to month in-order to optimize profits (Jonsson & Mattsson, 2009). The planning horizon for the S&OP process is between 3-24 months where monthly meetings are conducted which focus on supply and demand of product groups making necessary balance on factors such as revenues, customer service and costs (Shaikh, 2018). Bagni & Marçola (2019) mention that there are numerous literature from authors that have presented and explained similar S&OP models such as Palmatier & Crum (2003), Lapide (2004), Grimson & Pyke (2007), Wallace & Stahl (2008), Esper et.al (2009) and Thome et al. (2012) and from their paper a common Figure of S&OP is presented which is shown in the Figure 4.

Bagni & Marçola (2019) briefly describes the stages of S&OP wherein; the first stage of S&OP model consists of gathering and reviewing sales and production data of the previous month and

looking into present stock levels & backorders. The second stage defines the statistically forecasted sales plan for the coming months. This plan is generated based on automated IT systems and modified by field sellers, sales managers, and the marketing team. At this stage it is also important to ensure that marketing plans regarding product promotions are aligned with production plans. In the third stage the supply plans are discussed based on the new sales plan. Stage four consists of meeting the entire S&OP team to present wherein topics on demand and supply constraints are discussed. At this stage, the revenues of the firm are analyzed, and the sales and supply teams together provide a solution or alternatives if required. Stage 5 consists of meeting executives to present results of the previous month and discuss the risk and opportunities for coming months.

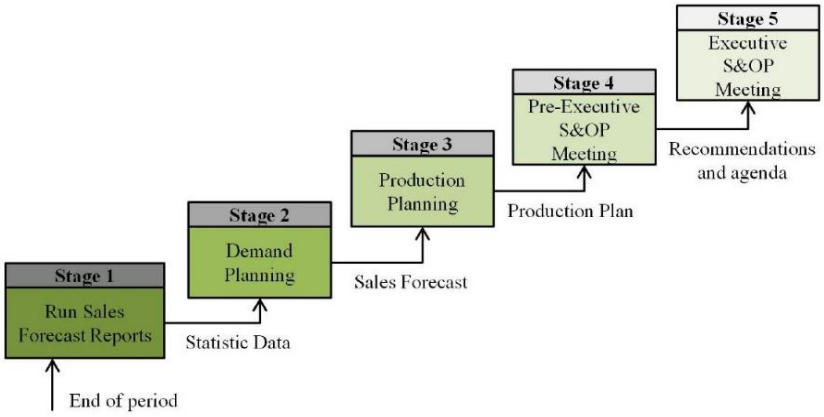


Figure 4: *Stages of S&OP process. Source: Adapted from Bagni & Marçola (2019)*

Lapide (2011) defines S&OP process as a routine tactical process which synchronizes supply and demand plans looking over a medium-term planning horizon. Lapide (2011) discusses about S&OP planning and distinguishes it from different types of planning i.e. strategic, tactical and operational planning. With regards to S&OP the tactical plans have a medium-term planning horizon i.e. 3-24 months and use time buckets of months and weeks. The plans are more detailed and are frequently changed. The Figure 5 below shows the relation between the strategic plan, the level at which the S&OP process is conducted and its connection to executing daily operations which influences the performance of the company.

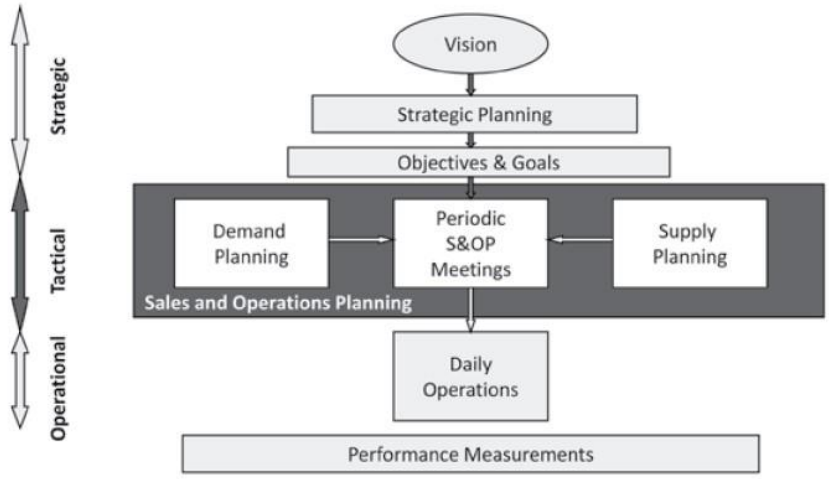


Figure 5: *Routine Tactical Planning process. Source: Lapide (2005)*

Regarding Anthony's hierarchical model, S&OP possesses a tactical role that connects strategic plans with operational plans, hence it would be rational to place the S&OP in the tactical level of Anthony's triangle as shown in Figure 6.

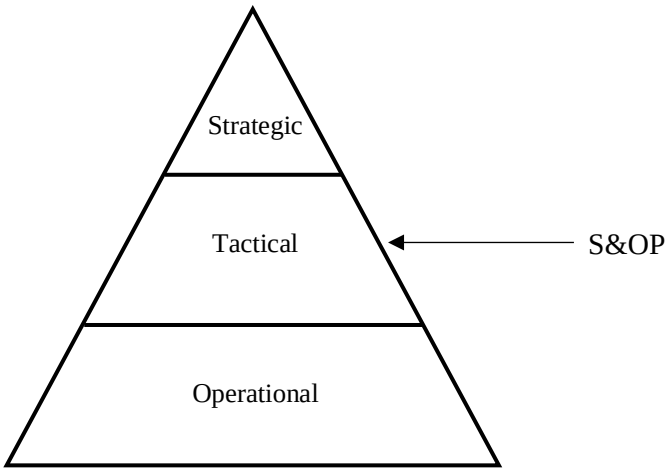


Figure 6: *The role of S&OP in Anthony's planning Hierarchy. Source: Carvalho (2018)*

Carvalho (2018), Bower (2018) and Pukkila (2016) discuss that it is evident that many companies perform S&OP process differently i.e. with shorter planning horizon where forecasts are generated based on SKU's and conducting S&OP process for weekly cycles. Therefore, it is understood that companies are looking for a more agile process, but also, shorter term and closer to the operational task than S&OP which in this case leads to the process of S&OE.

2.4 Sales and operations execution

The definitions of S&OE process varies, but, according to Carvalho (2018, p89) and Hippold (2019), “the sales and operation execution is defined as the process that connects the tactical planning to operational planning and execution by breaking down the tactical plans generated from S&OP into disaggregated information”. S&OE enables alignment of what was planned in the S&OP process to what is being executed. Carvalho (2018) presents Anthony’s triangle of the planning hierarchy wherein the S&OE process would be placed between the second and third layer as shown in Figure 7.

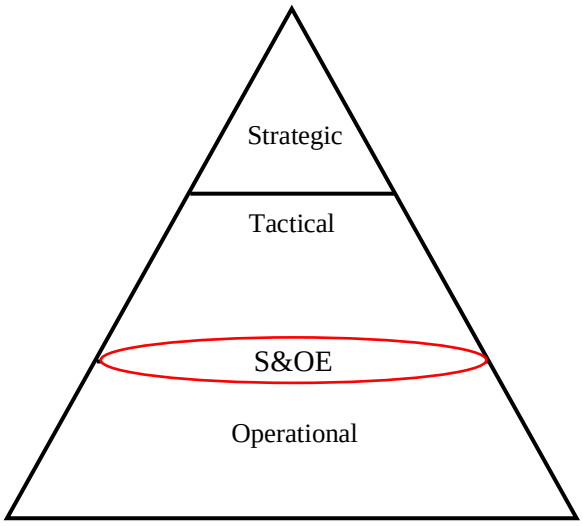


Figure 7: *Representation of S&OE in planning hierarchy. Source: Carvalho (2018)*

In general, the main motivation for the development of the S&OE is for companies to satisfy demand in volatile planning environments. An important aspect of these processes is the collaboration between sales function and supply chain planning function and operations. There are several bottom-line benefits, but a few of them are reduction in inventory approximately by 25% and customer service improvement (Holmes, 2015). Many companies that have invested in the S&OP have acknowledged that overtime planning environments with high uncertainty are difficult to cope with and that conventional planning hierarchy and S&OP aligned with MPS hardly provides the expected outcome of S&OP (Carvalho, 2018). In response to this, companies are deliberately seeking for various business processes that provide agile planning and execution for a volatile environment. Companies have started to adapt weekly S&OP process with a focus on short term horizon, weekly meetings and disaggregated plans that enables them to respond to such business environments. S&OE, as an agile business process is used to tackle the unfavorable business environment with an objective to link the S&OP to the MPS.

S&OE is a granular process which focuses on a daily and weekly demand and supply variations which requires execution of a tactical plan i.e. observing demand and supply data and making the required changes on a daily basis to obtain a balance on demand and supply. This is done by focusing on executing plans on a shorter horizon of 0-13 weeks rather than 3-18 months which occurs in the S&OP process. Moreover, S&OE is a process that unfolds the tactical S&OP plans into less aggregated information that is easier to understand and execute. As a result, the S&OE process provides effective communication and aligns cross-functional teams and stakeholders. Meetings conducted in S&OE are focused more on item level such as SKU's, shipments, fill rates, inventory levels etcetera. By focusing on a more granular level, it is possible to obtain more flexibility in terms of variations in demand and supply, prevent stock outs, increase sales, and overall optimize profits.

2.4.1 S&OE Fundamentals

According to Chainalytics (2019), the fundamentals of S&OE required to have an end to end workflow are , namely, about the decision that can be made from S&OE, the inputs and outputs of S&OE, S&OE horizon and data hierarchies that should be set for the process. These are explained in detail below.

Decisions Made in S&OE process

The sales and operations execution process are mainly used to disaggregate or spread the latest S&OP monthly plan into weekly plans to determine and act on deviations that occur between the latest S&OP plan to operational details. The decisions that are made to act on daily deviations "help to define the business logic needed to make the S&OP plan actionable" (Chainalytics, 2019, p.5). This also sets the business rules for "criteria and threshold" in identifying an accurate forecast vs actual deviation and actions that follow" (Chainalytics, 2019, p.5).

S&OE Outputs and Inputs

The outputs (plans and decisions) in S&OE process are the actions and alerts that require the attention and execution by human organizations, it can also be the data that is inserted into other processes and IT systems, for e.g., MPS (Chainalytics, 2019). Each output that is generated needs a "definition" for the receiver to perform any actions. Inputs for these actions and alerts are created depending on the requirements of the output. For e.g. an output would be a Demand manager receiving an alert due to an unanticipated order quantity of an item from a customer when compared to previous week's demand. The input would depend on the necessary action to take place, for instance, it can be rescheduling the order due stock unavailability, the order can be split into two delivery dates, reconfirm why such order has been placed, and so on.

S&OE horizon

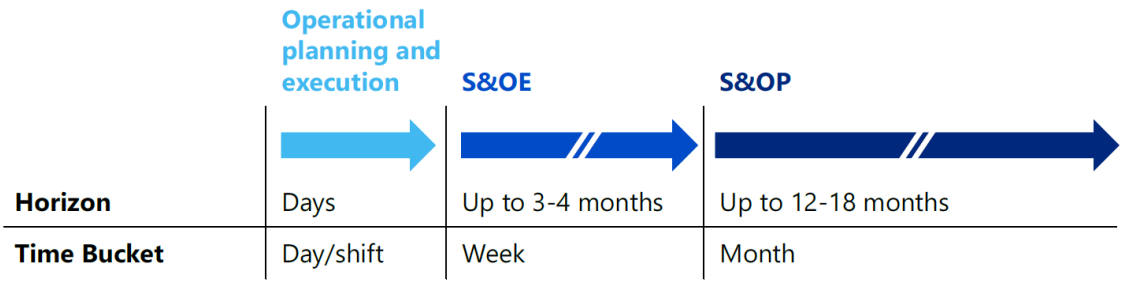


Figure 8: *Planning horizon and time buckets. Source: Chainalytics (2019)*

Planning horizon as defined by Jonsson & Mattsson (2009, p.45) is "the amount of time a plan extends into the future". The planning horizon for the S&OE process is 0 to 3 months (Carvalho, 2018). The Figure 8 indicates that the S&OE horizon ends when the S&OP horizon begins, and the length of the S&OE horizon should be identified depending on the type of business or industry. The S&OE process in some businesses begin instantly or for e.g. when implying to manufacturing business it can begin at the end of the frozen production period (Carvalho, 2018).

Data hierarchies of S&OE

Data hierarchies is a design for the planning hierarchies of the data which enables the users to have access to the right level of detail for their planning process. For instance, one of the designs for S&OP is a process done on monthly cadence over a subregion on product group level. In terms of S&OE process, since it provides a detailed planning result it requires a higher level of granularity. For e.g., Figure 9 shows the planning hierarchy design for S&OE would consist of a time with weekly cadence, country in geography or customer level and product level in product code or material code.

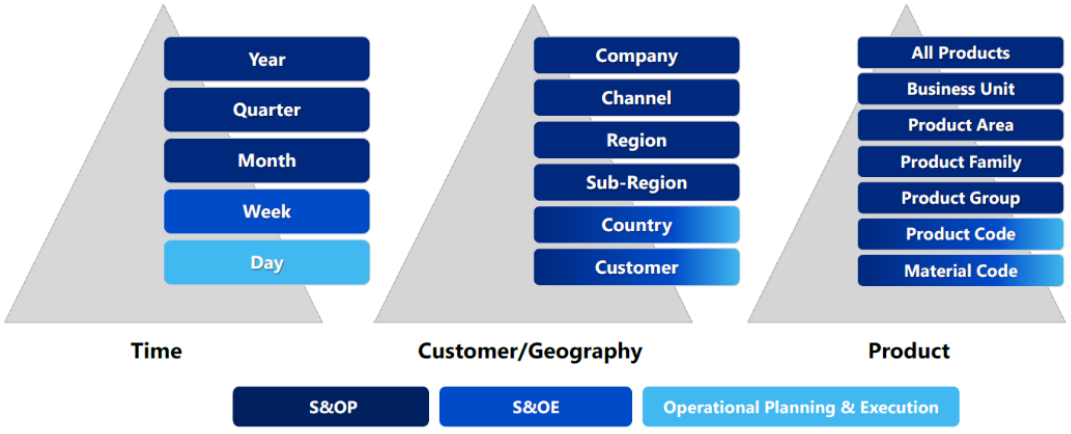


Figure 9: *Data hierarchies. Source: Chainalytics (2019)*

S&OE process deployment

The Figure 10 depicts the S&OP process deployment by Chainalytics (2019). As seen in the Figure 10, the S&OE follows a step-by-step process which is explained below:

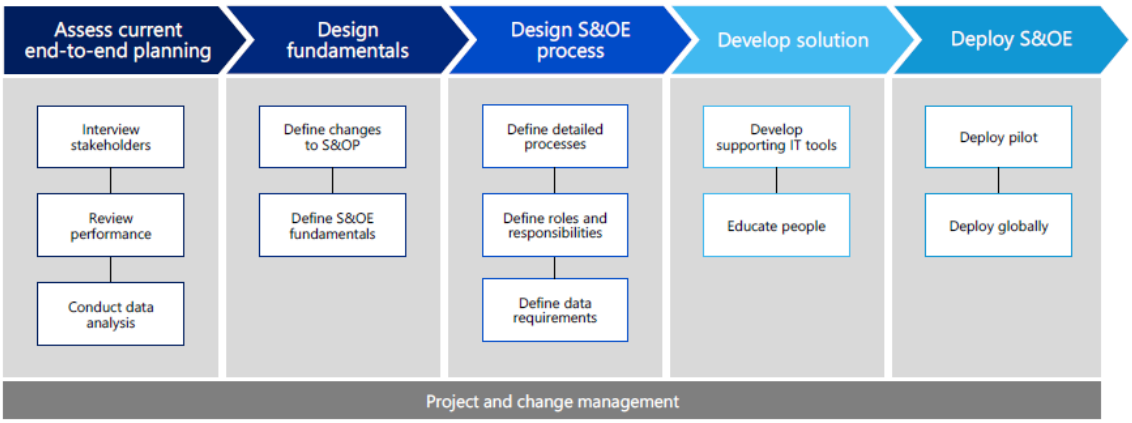


Figure 10: *S&OE process deployment. Source: Chainalytics (2019)*

Assess current end-to-end planning

In order to initiate the S&OE process it is mandatory to analyze the present end to end planning in the current business environment. The paper by Yeung (1995) describes that collecting data by conducting interviews provides more depth and enriches the quality of data. Therefore, to start the assessment of the current planning process it is a requirement to conduct interviews by executives with stakeholders in markets that have low performance in satisfying demand. For instance, the lack of performance could be an organization that is unable to satisfy demand due to demand uncertainties or have problems related production. Hence, by conducting unstructured interviews and gathering and analyzing data related to the customer demand and products sold insights can be gained on the current end-to-end planning process.

Design fundamentals

Depending on the performance review by executives based on data analysis of the specific markets that find it challenging to match demand and supply; decisions are taken by executives to make necessary changes to S&OP plans. The changes to S&OP plans consider the implementation of S&OE fundamentals which is explained in the previous sections. As explained by Carvalho (2018) the S&OE oversees assessing the problems that arise and finding a solution that aims on satisfying the S&OP result but with granularity and frequency that is narrowed down to answer certain questions. For instance, the frequency of meetings that are conducted in S&OP can be changed from monthly to weekly meetings. By having weekly cross functional meetings,

it provides much faster transparency between departments wherein a mutual agreement can be made to satisfy an uncertain demand. Examples such as these are used to define the fundamentals of the S&OE to stakeholders to make S&OP plan actionable.

Designing the S&OE process

Explaining the fundamentals is a significant step, based on the S&OE fundamentals that is established with stakeholders; executives take the next step to design the S&OE process. In this step the S&OE process is designed according to the organization's requirements and then explained to stakeholders on how the process should be conducted. Usually the S&OE is designed based on observing demand and supply data and making the required changes on a daily basis to obtain a balance on demand and supply. The S&OE process is explained in terms of the planning horizon, focusing on SKU's that possess volatile demand, keeping track of orders and shipments and keeping track on S&OP plans. Each stakeholder is given a specific role and responsibility in executing the S&OE process. For e.g. the role of a sales executive would be to generate a demand according to the production capacity of the company and not naively aiming to hit the sales target.

Developing solution

To solve the problems identified technology is essential to any organization. Lapide (2005) mentions that business processes without the presence of information technology becomes a burden to employees in the organization. Therefore, to support the large scale of benefits that the business processes can offer technology becomes a necessary asset. According to Carvalho (2018), one of the main systems used to facilitate the process of S&OE is the ERP system as it helps monitoring the operations but other systems such as the MPS and the MRP can also be used to derive the order from customers. In order to support the weekly meetings Carvalho (2018) discusses the S&OE cockpit that should be developed in order to facilitate the weekly meetings. This cockpit serves as an information tool with logic to operationalize the process of S&OE. The cockpits can be dashboards, BI tools or simple excel sheets. With the supporting information technology in place, enlightening the stakeholders on what information should be assessed to make final decisions is very important. Hence, for the S&OE process executives develop KPIs for specific markets and integrate the demand data on SKU level to the S&OE cockpit for stakeholders to act upon.

Deploying S&OE process

In order to implement an S&OE process globally it is very essential to select a market with the problem such as handling demand uncertainties by deploying a pilot project, it helps organizations to control and minimize the risk. Testing a project in a controlled manner allows stakeholders to

assess the effects and discover unanticipated outcomes. Once the process is modified for the expected outcomes it is then ready to be deployed globally.

2.5 Relation of S&OE process to other planning process

2.5.1 Reconciling sales and operations management

In an article by Lim, Alpan, & Penz (2014, p.23) wherein it describes a new planning process used in an automotive manufacturer Renault. The process being "a hybrid intermediary between S&OP and MPS". In this planning process the sales department conducts a weekly demand forecast every month for the next three months with a low product aggregation level focusing on a weekly bucket. Although the Lim, Alpan, & Penz (2014) do not provide a name for this process and the motivation to use this process is different it highly resembles S&OE.

Upon researching on the topic of S&OE it was also recognized that this process can also be related to the workings of the master production schedule (MPS). Based on Jonsson & Mattsson (2009, p179) the MPS is "defined as a process which involves establishing plans for a company's sales and production operations. The main concept of MPS is to synchronize demand and supply in a way that company's efficiency and competitiveness are promoted. The plans for production in the MPS are extracted from demand forecasts of the future and the process is conducted more than once a month just as it is done for the S&OE process. But, the relation to S&OE cuts off as the MPS is more of an automated calculation procedure" for make to stock (MTS) and make to order (MTO) companies (Jonsson & Mattsson, 2009). Moreover, the MPS is a manufacturing planning tool administered by a master production scheduler who transforms the aggregate plans to specific end items that are required to be produced within a time period whereas the S&OE is more of an executional business process. In an advanced manufacturing company, the MPS would perform the automated calculation for the specific items to be produced.

2.5.2 Demand control

According to Bower (2018) demand control is also sometimes called sales and operations execution. Holmes (2015) & Lindsey (2019) have also worked on a similar concept called demand control which is explained in the next section. Holmes (2015) defines "demand control is a process to manage when demand materializes differently than planned in the near term, liberating sales, marketing, and demand planning organizations to focus on the long term 5-25 month horizon and addressing short term supply planning priorities, capabilities and concerns".

With demand materializing differently than planned in the near term means that there could be two scenarios.

Scenario 1: "If the demand is greater than planned in the near term and there are insufficient products available to fulfill customer orders to the requested date by customers". This situation arises mainly due to poor behaviors of customers. In this scenario, the demand controlling process highlights the sales organization of unproductive customer behavior and gives them a process to prioritize the demand by giving them authority to make stock allocation decisions. This demand controlling process gives confidence to sales that their priorities are being executed. But there may arise a situation where the individual sales representatives may not always get their way, but they get to know the priorities through the demand control meeting. For example, in such a situation, companies can prioritize selling orders which are giving good margin to the company (Holmes, 2015).

Scenario 2: "If the demand is less than planned in the near term, there will be excess inventory buildup and reductions in sales revenue and volume". This may force supply chain planners to avoid critical cost overruns such as excess inventory or expired inventory. These actions taken by the supply chain planners do not consider the timing of demand. For instance, actions such as, manipulation of forecast directly to the system or not rolling unconsumed forecast into the following period to protect against excessive inventory (Holmes, 2015).

Demand control meeting structure

The agenda of the demand control meeting is as shown in Figure 11 is to review the normal demand, products which are available to promise, discussion on abnormal demands from the customers, discussion on exception demand management between demand execution manager and supply planners and finally discussion on forecast consumption. It is the responsibility of Demand execution manager to have a clear communication of decisions and actions and understanding the impact of the decisions taken.

Figure 11: *Agenda for demand control meeting. Source adapted from: Lindsey (2019)*

The inputs for the S&OE process are aggregate and detailed plans, assumptions made, customer sales plan, customer orders, distribution replenishment plans brought by different stakeholders. The stakeholders involved are sales manager/director, supply planning manager, demand planning manager, customer service manager and others depending on organization, for example, transport manager, warehouse manager, etcetera (Lindsey, 2019). The output of these demand control process would be mainly to increase the demand plan accuracy and management of unplanned and planned demand. In addition to that, there is an increase in visibility and stability to the master scheduler and since all sales and marketing representatives participate in the weekly meetings, this enables better integration between sales and supply organization, ultimately, maximizing the business opportunities (Lindsey, 2019).

2.6 Carvalho's proposed model

Carvalho (2018) performs a literature review along with case studies of four companies with a goal to formalize the S&OE process. These case studies were conducted across different industries that identifies the main characteristics of S&OE process i.e. differences in S&OP, gains obtained with the implementation of S&OE and determining greater challenges of the S&OE process. Among these case studies conducted, the first is a pilot case study in the energy industry. The remaining case studies are conducted in the ceramic tiles industry, footwear and cosmetics. The intention to use Carvalho (2018) model of S&OE is due to the reliability of data that Carvalho (2018) presents based on the cross-case analysis of four companies from various industries which also provides detailed characteristics on each domain of the S&OE model of Pukkila (2016).

As seen in the Table 1, based on Carvalho (2018) S&OE model, the S&OE process is conducted over a 3 months horizon with a weekly planning bucket that focuses on SKU level for critical products and one level higher for non-critical products. By segregating the items based on its criticality it enables S&OE participants to respond quickly and provide decisions for items that undergo abnormal demand. For the S&OE process it is important that an S&OE team is created. The S&OE team consists of managers or coordinators who are from the areas of production, inventory, logistics, sales, supply chain, marketing, and IT. These participants are responsible for analyzing data to elaborate on reports, monitor KPIs and follow up daily on deviations and look for opportunities related to abnormal demand. The meetings are initiated by an S&OE leader who could be a manager or coordinator, but the leader should have the mindset of aligning the activities of the S&OE process to the S&OP plan. This way, by performing activities on the shorter horizon it contributes to aligning the strategic goal of the S&OP process. The S&OE leader should possess characteristics of being unbiased and think of the company in order to make decisions regarding

trade-offs. This leader is also a primary participant of the S&OP process and hence should be able to assess the best scenario for the company with a systematic vision for a longer horizon.

The scope of the S&OE process is to promise on executing the S&OP plans, synchronizing the customer demand from the order book with production and purchasing plans and promise on sustaining or increasing the agreed service level for customers. Decisions that are made in daily operations should be done by the S&OE team who have full knowledge of the company and the autonomy to do so. Decisions pertaining to longer horizons which can affect other functional departments or even involve tradeoffs should be only done through the forum present in weekly S&OE meetings.

The most important technologies which facilitate the S&OE process is the ERP, with MPS and MRP functionalities. By using information from the ERP system, it is possible to monitor and operationalize the S&OE with an order fulfillment logic which later can be used to manage the deviations in customer orders. If the company possesses a higher maturity in terms of technologies used in their business process the advanced planning system can also support the S&OE process. In addition, an efficient tool can also be the S&OE cockpit where participants can follow-up on KPIs and monitor products daily on SKU level.

Carvalho (2018, p.91) mentions that KPIs in the "S&OE process are mostly related to service level, order fulfillment and balance between supply and demand" i.e. production and order book. Hence, the most common KPIs in this process is OTIF (order fulfillment), "adherence to the programs including production, distribution and purchasing, Inventory health i.e. stock out, excess stock, reproved stock. Service level, backlog" and change in customer orders. Overall, the S&OE process generates value by making the S&OP plans tangible by reacting to changes that occur in the short-term which occurs in the demand forecasts, sales orders and reducing the inefficiencies related to rescheduling the production and sales orders. Table 1 below presents the S&OE characteristics discussed by Carvalho (2018) proposed S&OE model.

Domains	**Main aspects**	**Carvalho (2018)**	**Gartner Webinar**
Process model	Horizon	3 months	3 months
	Bucket	Weekly	Weekly
	Product segregation level	SKU (Stock keeping units) level for critical products, subfamily for non-critical products.	SKU
	Meeting frequency	Once a week	Once a week
S&OE process roles and responsibilities	S&OE leader	An individual who is facilitator and responsible for coordination of S&OE	A leader from Supply Chain who is responsible for

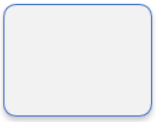
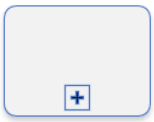
		activities. Owner of S&OE meeting and a participant in S&OE meeting.	making decisions related to S&OE such as tradeoffs.
	S&OE team	There is a dedicated S&OE organization with a team of demand analysts "responsible for running the systems to generate programs, analyze information to elaborate reports, monitor KPIs, daily follow up on deviations and looking for opportunities" (Carvalho, 2018, p.91). The S&OE team should have autonomy for making small and routine decisions related to S&OE.	Here, both demand planner and supply planner make decisions concerning trade-offs.
S&OE Decision making	Scope and triggers	The scope and trigger include "guaranteed S&OP plans, balancing of order book against production and purchasing plan, ensure fulfillment maintaining agreed service level" (Carvalho, 2018, p.91).	The scope includes rectifying plans and adjustments by considering the orderbook.
	Autonomy	"Routine decisions that are provided in daily operations, provided they have knowledge and autonomy to do so. Decisions that affect longer periods and that can have impact on several functional areas should be made by the forum present in the S&OE meeting" (Carvalho, 2018, p.91).	The decisions are made by the supply chain leader and some decisions are made by the team.
S&OE Functional areas	Owners	Production planning and control or supply chain, also depends on company's organizational structure	Supply chain
S&OE Tools and technologies	Supporting technologies	ERP - MPS & MRP. For a higher degree of maturity APS can be used.	ERP
	S&OE cockpit	Excel or Access tools	

S&OE Key performance indicators	KPIs	1. OTIF (On time in full) 2. Adherence to the programs 3. Inventory health (stock out, excess stock, reproved stock, etcetera. 4. Service level 5. Backlog 6. Change in sales order 7. Effectiveness KPIs can also be chosen depending on the company's strategies and business model.	Forecast Consumption, Out of plan risks, Schedule attainment- delivery performance (OTIF).
Relevance	Strategic alignment	"S&OE is an enabling process which also considers strategic plan to make sure the important drivers of strategic business plan is agreed and followed up during operational execution activities" (Carvalho, 2018, p.92).	S&OE is a granular process which focuses on daily and weekly demand and supply variations which requires execution of a tactical plan the responsibilities of S&OE includes analyzing scenarios and identifying solutions for problems generated with focus on achieving better S&OP results.
	Value creation	"The S&OE process creates value by bridging S&OP tactical plans to operational execution" (Carvalho, 2018, p.92). This is done by reacting to short-term changes in demand forecast, sales orders received from customers and minimizing cost related to lack of efficiency of production and sales orders.	S&OE creases smooth flow for operations. Exceptions are detected with anticipation and solutions to problems are found in the correct forums with the right stakeholders.
	Goals and expectations	"The goal is to connect tactical planning to operational execution and unfold tactical plans into less aggregated information with high granularity of data" (Carvalho, 2018, p.92)	The main goal is to keep track of S&OP plans, disaggregating S&OP plans to weekly plans for the short-term planning.

Table 1: *Characteristics of S&OE process. Source: Carvalho (2018) and (Pukkila, 2016)*

2.7 Business process flow chart

To begin evaluating the current state, there is a necessity of a business process modeling language that could be easily understood by business users and process implementers. We use Business Process Model and Notation (BPMN) developed by Object Management Group (OMG) to develop the current state. BPMN has become the de-facto standard for business processes diagrams. The intent of using this Business Process Model and notation is to provide a notation that is readily understandable by all business users from the business analysts that create the initial drafts of the processes to the technical developers responsible for implementing the technology that will perform those processes, and finally, to the business people who will manage and monitor those processes (OMG, 2011). The basic modeling elements used for the current state is explained in Table 2.

Element	Notation	Description
Activity		An activity is a work that an organization performs within a business process.
Collapsed sub-process		An activity is a sub-process when it has a lower level of detail.
Start		Start of the event indicates where a process will start.
End		End of event indicates where a process will start.
Sequence flow		This notation is used to show the flow of activities in a sequence.

Message flow		This notation depicts the w the flow of messages between two participants that are prepared to send and receive them.
Association		An association is used to link information and Artifacts with BPMN graphical elements.
Gateway		It is the decision point that can be adjusted based on conditions or events.
Data object		Data objects provide information about what activities are required to be performed.
Pool / Lane		A pool is the graphical representation of a participant in a collaboration. It also acts as a swim lane and a graphical container for partitioning a set of activities from other Pools, usually in the context of B2Bsituations.

Table 2: *Business process model and notation. Source: OMG (2011)*

2.8 Review of roles and responsibilities

One of the research foci related to this thesis paper is to define the roles and responsibilities of stakeholders involved in the process. Hence, it is ideal to have a tool that can provide a consensus which indeed clearly states who is to do what, with whom and when. This tool is called the RACI matrix and is considered as one of the famous tools for assigning roles and responsibilities with respect to project management. According to Nevin (2014), the RACI matrix present a structure and clarity in describing the roles that stakeholders play within the project and the RACI charting definitions can be described as follows:

- *Responsible(R):* "People or the stakeholders who do the work or also known as the doers" (Kantor, 2018). These are the stakeholders who complete the task or objective

or make the decision. The responsibilities within a project or a process can be shared i.e. multiple people can be held responsible for tasks or activities.

- *Accountable(A):* "A person or stakeholder is said to be accountable when he is the owner of the work" (Kantor, 2018). He or she has the authority to sign off or approve when the task, objective or decision is complete. With respect to accountability, as per RACI charting, only one person can be held accountable. This is justified by Nevin (2014).
- *Consulted(C):* People or stakeholders who undertake consultant roles are supposed to give input prior to a final decision or any actions taken. For instance, these people are known as subject matter experts and are always considered to be kept in the loop.
- *Informed(I):* "These are individuals or stakeholders who need to be kept in the picture" (Kantor, 2018). This means that the individuals need to be informed regarding any updates on progress or decisions, but it's neither necessary to be formally consulted, nor do they contribute directly to the task or decision.

RACI charting involves a six-step process which begins with identification of actions that will develop relationships followed by the definition of decisions and activities to the RACI chart. In the third step, the stakeholders or departments involved in a process or project is added. Once the chart is developed, the general is to assign Rs followed by "As", then complete the chart with "Cs" and "Is". In the final stage, feedback is secured and buy in is got from the stakeholders Nevin (2014). A RACI chart is depicted as shown in Table 3.

Process Model	Functional role or department	Functional role or department
Decision or actions	-	-
Decisions or actions	-	-

Table 3: *RACI matrix. Source adapted from: Nevin (2014)*

As mentioned before, the aim of the project is to review the roles and responsibilities of S&OE process with a focus on roles and responsibilities of the Operational demand manager who is the facilitator of the S&OE process. With respect to literature, Operational demand manager is also known as demand execution manager, but, when considering different companies there is also a role called "demand fulfillment manager or demand planning and fulfillment manager" depending

on those companies. According to Lindsey(2019) and Holmes(2015), the demand execution manager should be the facilitator of the demand controlling process ensuring sales participation and prioritization in decision making and he/she is also responsible for monitoring the customer orders against the demand plan in the short-term horizon and is the owner of the process. Demand execution manager should be a trusted person by the functional leaders in sales, marketing, demand planning and supply chain planning (Lindsey, 2019). Holmes (2015) & Lindsey (2019 lists out 5 main elements with respect to the roles and responsibilities of demand execution manager:

- Order management- Analyze the historical database with customer orders received and give feedback on abnormal demands.
- Management when demand is greater than supply i.e. aids sales in prioritization of demand.
- Management when demand is less than planned i.e. alerting the sales when demand is less than planned.
- Facilitate decision making when demand materializes than planned.
- He/she should have a detailed understanding of the agreed plan in ERP and should monitor the actual demand on a daily basis.
- Identifying and managing the abnormal demand and is responsible for forecast roll and tactical maintenance of forecast. Demand execution manager also should be aware of supply interface failures and alert the necessary stakeholders about this.

2.9 Maturity model

Maturity models is a widely accepted technique for assessing the business process or some aspects of the organization as it provides a path for improvement in an increasingly systematic and organized way. According to De Bruin et al. (2005) the application of maturity model is to use on the basis evaluation and comparison for the improvement of the business process. This feature of maturity model enables to derive an informed approach to increase the capability of a selected domain within an organization. To begin with the selection of maturity models, Van Looy et al. (2013) questionnaire was used to identify the maturity model based on the criteria set by us. The most important criteria set by us were to develop a maturity model based on basic capability, explicit prescriptive, supply chain domain specific, collection of qualitative data and inclusion of internal respondents for the maturity model. Based on these criteria assessment and decision tables from Van Looy et al. (2013), it was understood to apply Global SC maturity framework by Aberdeen Group with current requirements set by the us. In this maturity model, the categories

used were process, organization, resource effectiveness, IT architecture, decision making, and collaboration. But it was ideal to use a framework which combines both Aberdeen framework approach and Lapide (2005) framework called Grimson & Pyke (2007) because this model stresses on the great potential of profit optimization. Hence, Grimson & Pyke (2007) is considered for the development of S&OE maturity model. Further reasoning as to how Grimson & Pyke (2007) model is adapted is explained in "Analysis and discussion" section of the report.

2.9.1 S&OP maturity model

Grimson and Pyke (2007) develop a S&OP maturity model with the aim of evaluating a company's current level of S&OP integration, which is also useful from a perspective of recommending a firm to progress to the next stage of maturity in S&OP integration. Figure 12 represents the Grimson and Pyke (2007) S&OP maturity model.

	Stage 1 No S&OP Processes	Stage 2 Reactive	Stage 3 Standard	Stage 4 Advanced	Stage 5 Proactive
Meetings & Collaboration	• Silo Culture • No meetings • No collaboration	• Discussed at top level management meetings • Focus on financial goals	• Staff Pre-Meetings • Executive S&OP Meetings • Some supplier / customer data	• Supplier & customer data incorporated • Suppliers & customers participate in parts of meetings	• Event driven meetings supersede scheduled meetings • Real-time access to external data
Organization	• No S&OP organization	• No formal S&OP function • Components of S&OP are in other positions	• S&OP function is part of other position: Product Manager, Supply Chain Manager	• Formal S&OP team • Executive participation	• Throughout the organization, S&OP is understood as a tool for optimizing company profit.
Measurements	• No measurements	• Measure how well Operations meets the sales plan	• Stage 2 plus: • Sales measured on forecast accuracy	• Stage3 plus: • New Product Introduction • S&OP effectiveness	• Stage 4 plus: • Company profitability
Information Technology	• Individual managers keep own spreadsheets • No consolidation of information	• Many spreadsheets • Some consolidation, but done manually	• Centralized information • Revenue or operations planning software	• Batch process • Revenue & operations optimization software – link to ERP but not jointly optimized • S&OP workbench	• Integrated S&OP optimization software • Full interface with ERP, accounting, forecasting • Real-time solver
S&OP Plan Integration	• No formal planning • Operations attempts to meet incoming orders	• Sales plan drives Operations • Top-down process • Capacity utilization dynamics ignored	• Some plan integration • Sequential process in one direction only • Bottom up plans - tempered by business goals	• Plans highly integrated • Concurrent & collaborative process • Constraints applied in both directions	• Seamless integration of plans • Process focuses on profit optimization for whole company

Figure 12: *S&OP Maturity model. Source: Grimson and Pyke (2007)*

This model includes five dimensions which is both business and information process. It is set across a 5-stage ranking wherein the first stage is classified as a company having no S&OP practices which is the lowest level of maturity till the 5th stage which is classified as a proactive stage i.e. highest level of maturity. It is important to note that the Lapide (2005) model is used as a reference to construct this model. Therefore, Bagni & Marçola (2019) state that the main difference between these two models is the introduction of two new dimensions which is "organization" and "performance indicators". Bagni & Marçola (2019) briefly describe the S&OP model developed by Grimson and Pyke (2007) as described below:

Meetings and Collaboration

This is the first dimension of the model which considers the human factors or components involved in an S&OP meeting. According to Bagni & Marçola (2019), there are two conditions that are assessed in this dimension. The first is the scope of meetings i.e. to check if there is involvement from only executives or if there are also specialists and supervisors who take part in S&OP meetings. The second condition that is assessed is the level of authority given to the participants to make decisions depending on issues that arise i.e. "the autonomy that the employee has to make decisions on how to solve problems" (Bagni & Marçola, 2019, p.7).

In earlier stages, there are neither official or formal meetings for S&OP nor any collaboration of departments within the company, it is constrained to top management and focused only on financial goals. As stages progress in the S&OP model meetings are more formal and scheduled, employees from each cross-functional department attend the meetings. They also involve major customers and critical suppliers for their S&OP meetings in order to align demand and supply (Bagni & Marçola, 2019).

Organization

Organization is the second dimension of the model which focuses on the S&OP structure in the firm (Grimson & Pyke, 2007). The initial stages of the model represent that the company has no knowledge about S&OP and as the stages gradually progress to more maturity S&OP definition is established and its benefits are recognized. In final stages of maturity, the process of S&OP is involved in all business areas within the firm with a formal structure which is relevant to the firm. For e.g. as companies progress to final stages of the model; a formal S&OP team exists in the firm where only top executives of the firm participate.

Performance Indicators

The performance indicators assess the effectiveness of the S&OP process in the firm. Bagni & Marçola (2019, p.7) state that the third dimension primarily evaluates the "degree of comprehensiveness among other functions of the organization". In the initial stages of the model it presents that companies lack any kind of measurements (KPIs) to determine the effectiveness of S&OP process. While progressing to higher maturity companies introduce performance indicators that cover sales and supply i.e. companies evaluate on how well the operations department meets the demand plan (Grimson & Pyke, 2007). Companies also measure the accuracy of forecasts determined by the sales organization. In the final stages of maturity, the firm focuses on how the S&OP process is effective in introducing new products while looking at the profitability perspective.

Information Technology

In the S&OP process the integration of software application is very crucial as it combines and presents information of demand and supply from cross-functional departments. Like the Lapide (2005) model in the initial stages the firm only uses spreadsheet to manage data which is done individually by different departments; there is no consolidation of data. As the maturity of the S&OP process progresses information is frequently updated and collaborated with different departments in S&OP workbench (Grimson & Pyke, 2007). This enables the firm to obtain visibility in data which is easier to balance both supply and demand. In higher stages of maturity advanced software applications are used where demand is retrieved in real time and it is directly integrated into the company's software. By this, firms can get integrated solutions from combined sales and operational decisions.

Integration between Sales and Operations

According to Grimson & Pyke (2007) this dimension measures on how effectively a company builds its sales and operation plans for integration. The whole purpose of this model is to integrate both demand and supply plans with the help of meetings and collaboration, performance measurements, organizational changes and IT.

In the beginning stages of this dimension there are no formal meetings and collaboration within the firm, but, as maturity increases the demand plans lead the operational plans and gradually plans are integrated with one another. As firms progress to a higher maturity integrated medium-term plans are made where capacity analysis is used to restrict demand plans i.e. demand plans are made considering the production capacity. In the highest stage of maturity, the plans are completely integrated with a focus on optimizing company profits.

2.9.2 Contingency theory for the design of S&OP

A paper from Ivert et al. (2015) contributes to how companies design S&OP process contingent on the planning environment (PE). Previous literature on S&OP has made the S&OP process seem more generalized irrespective of the business planning environments which includes demand and supply uncertainties, product complexity, production network complexity etcetera that affect the outcome of S&OP. Ivert et al. (2015) uses the contingency theory to show that the S&OP process should be designed according to the PE in order to achieve positive outcomes from the process. According to Thome et al. (2014, p.769) contingency theory states that firms "adapt their structures and process" to the current state environment to obtain high performance. From a theoretical perspective S&OP process and practices must "fit manufacturing structure and the environment in order to positively impact upon performance".

Ivert et al. (2015) present an analytical framework adopted from Thome et al. (2012) which segregates PE variables based on product, demand & supply and organizes S&OP integration as setup and process parameters.

According to Ivert et al. (2015) setup parameters deal with the overall scope and principles of developing a manufacturing and control process, but, with respect to S&OP the setup parameters refer to planning horizon, planning frequency and planning object. Planning frequency is the frequency of meetings conducted and how regularly plans are updated. The planning frequency depends upon each company, it can either be monthly or quarterly (Ivert et. al, 2015). Planning horizon is the "amount of time a plan extends into the future". For S&OP process the planning horizon is usually between one to two years (Ivert et al., 2015, p750). Planning object is the level of detail the products are investigated for setting up the process. For e.g. in S&OP process the planning object is product families, but, in some cases SKU (stock keeping unit) are also investigated or both.

Process parameters in S&OP context are the inputs, activities and outputs. The inputs in this parameter consist of "plans, constraints, business goals, visions and strategies" (Ivert et al., 2015, p.750). For e.g. plans could be referred to as demand plans obtained from sales. The activities for S&OP according to Ivert et al. (2015) are: forecast generation, demand planning, delivery plan, supply plan and pre-S&OP meetings. The outputs in this parameter is the integrated and aggregated plans for sales, marketing and production. Figure 13 presents the analytical framework used by Ivert et al. (2015).

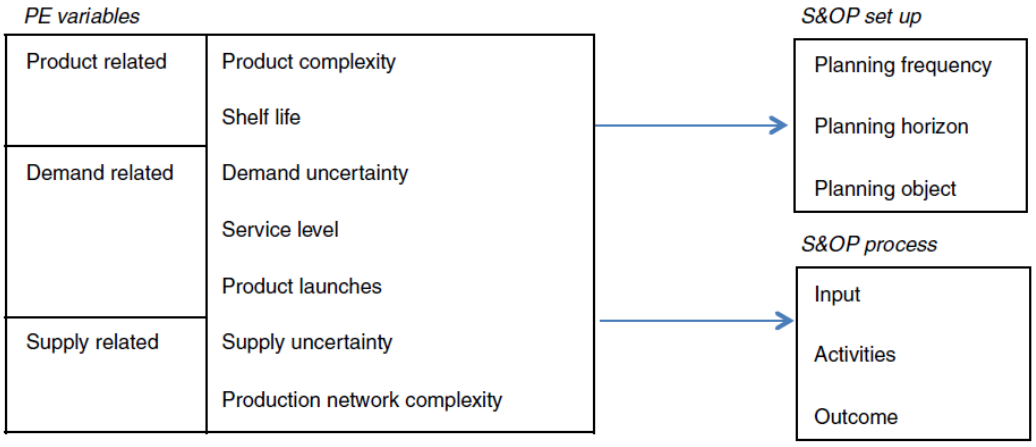


Figure 13: *Analytical framework. Source: Ivert et al. (2015)*

2.10 Demand planning maturity

According to Lindsey (2019) and Holmes (2015), demand plan is an important input for S&OE process. During the analysis of the S&OE process, the S&OP process was under implementation at SKF. Hence, it could be of value to understand the demand planning maturity and how the improvement of demand planning maturity can contribute towards the S&OE process. Hence the framework of Vereecke et al. (2018) is taken into consideration. The S&OP model discussed in previous sections gives more focus on assessing the maturity of the process of synchronizing and coordinating the sales and the operations plan. There is less attention given to maturity of the process of sales or demand planning and the process of operations or supply planning.

Vereecke et al. (2018) developed a demand planning maturity model that focuses on demand planning which is the main component of the S&OP process and provides a balanced perspective on demand planning maturity. The advantage of using this model is that it can be easily applied across the organization. Also, with the use of this model, the current state of demand planning can be determined. The Vereecke et al. (2018, p1633) proposed model for maturity assessment of demand planning consists of 6 dimensions measured by 33 best practices as shown in Table 4. The six dimensions include data management, use of forecasting methods, management of the forecasting system, performance management, forecasting organization and people management.

Sl no	**Dimension (Best practices)**	**Avg(std.dev)**
1	***Data management***	***3***
1.1	Use of historical demand data of all customers when forecasting	3.5 (1.1)
1.2	Use of additional internal data such as upcoming promotions, impact analysis of historical promotions, pricing strategy	3.0 (1.2)
1.3	Use of additional external data such as market trends, competitive moves, weather forecast	3.2 (1.3)
1.4	Well defined data ownership policy to which everyone in the company adheres	2.6 (1.2)
1.5	Collaborate with customers for exchange of information to improve data used for forecasting	
1.6	Collaborate with suppliers for exchange of information to improve data used for forecasting	3.4 (1.3)
1.7	Systematic updates of the data set	2.9 (1.2)
2	***Use of forecasting method***	***2.8***
2.1	Use of advanced statistical models and techniques	2.2 (1.2)
2.2	Complement statistical forecasting human judgement	3.7 (1.0)
2.3	Judgement from multiple individuals when composing forecast	3.4 (1.1)
2.4	Systematic log changes for human changes made to forecast	2.3 (1.1)

2.5	Adaptation of human judgment depending on situation such as strong product volatility, new product introduction, expert experience	2.4 (1.2)
2.6	A detailed tailored technique used for products with different characteristics	2.6 (1.2)
3	***Performance management***	***2.6***
3.1	Measure forecast accuracy	2.7 (1.3)
3.2	Linked KPIs with forecast accuracy	2.8 (1.2)
3.3	Continuous improvements KPIs	2.6 (1.3)
3.4	Different forecasting targets based on a combination of historical performance and specific market conditions.	2.0 (1.1)
3.5	Adjust forecast accuracy according to industry benchmarks	2.9 (1.4)
4	***Management of forecasting system***	***2.5***
4.1	Forecasting system has internal links with other systems in the company.	1.8 (1.1)
4.2	Auto generated forecasting reports	2.7 (1.4)
4.3	Forecasting reports access	2.7 (1.3)
4.4	Real time link with customers and forecasting system	2.6 (1.3)
5	***People management***	***2.9***
5.1	Forecasters have real access to relevant training	2.7 (1.1)
5.2	Experience of forecasting team	2.9 (1.2)
5.3	Communication skills of forecasting team	3.1 (1.0)
5.4	Analytical skills of forecasting team	3.1 (1.0)
5.5	Business expertise of forecasting team	3.4 (1.0)
5.6	Incentive system based on forecasting system	1.7 (0.9)
6	***Organization***	***3.2***
6.1	Full functional integration between different business areas involved in the forecasting process	2.8 (1.0)
6.2	All department commit to one forecast	3.0 (1.2)
6.3	Forecasting process receives explicit management support	3.3 (1.1)
6.4	Clearly determined ownership structure	3.5 (1.2)
6.5	Dedicated forecasting team	3.1 (1.4)

Table 4: *Demand planning maturity model. Source: Vereecke et al. (2018, p.1633)*

In the first dimension i.e. data management describes the first step of demand planning which explains the process of data collection. For companies using statistical forecasting techniques, the historical demand data forms an important input to the forecasting system in addition to internal and external data. These data need to be also updated systematically to have higher forecast accuracy. Hence, this dimension assesses the maturity of how the companies use historical data which is compiled with internal and external data. The second dimension explains the use of different forecasting methods taking into consideration of "account contingencies and product segmentation" (Vereecke et al., 2018, p.1630). With respect to the third dimension, it describes the number of systems which should be in place to ensure necessary flow of information. Fourth dimension i.e., performance measurement explains the different best practices adopted in

measuring the forecasting performance which includes use of forecast accuracy. In the fifth dimension, the organization structure required to have an effective demand planning is explained. With regard to organization, it is important to have good cross function integration, commitment from higher management of the company, clear ownership of forecast and a dedicated team. The last dimension of demand planning maturity model explains the people dimension i.e. the importance of the right set of skills and capabilities to be part of forecasting organization. The skills include experience and knowledge in analytics, statistics and good communication skills (Vereecke et al., 2018). These dimensions are also briefed in Table 4. The approach used in this model for survey is Likert-type scales which describes the top-level maturity based on the best practices with the levels implied by Vereecke et al. (2018) such as shown in Table 5.

Rating scale	Score
Never or does not exist	1
Sometimes or to some extent	2
Frequently or partly exist	3
Mostly or often exist	4
Always or definitely exist	5

***Table 5**: Rating scale. Source: Vereecke et al. (2018)*

3 Methodology

This section describes the methodology adopted when conducting the thesis and it consists of research method, data collection methods, and model of analysis used for research questions and finally the research quality criteria which includes reliability and validity of the research.

3.2 Research approach

Sales and operations execution is a relatively new concept compared to S&OP and the amount of academic work that exists on this topic is very limited. Hence, there was a need for a method which is used by researchers to develop new knowledge. When looking at the working of abductive research approach, "it also works through interpreting an individual phenomenon within a contextual framework and tries to understand a concept in a new way, from the perspective of a new conceptual framework" (Kovacs & Spens, 2005, p.138). Therefore, the approach adopted for this thesis is the abduction research approach which is illustrated as shown in Figure 14. With respect to this thesis, an abduction approach is used for all the research questions which will be explained in later sections.

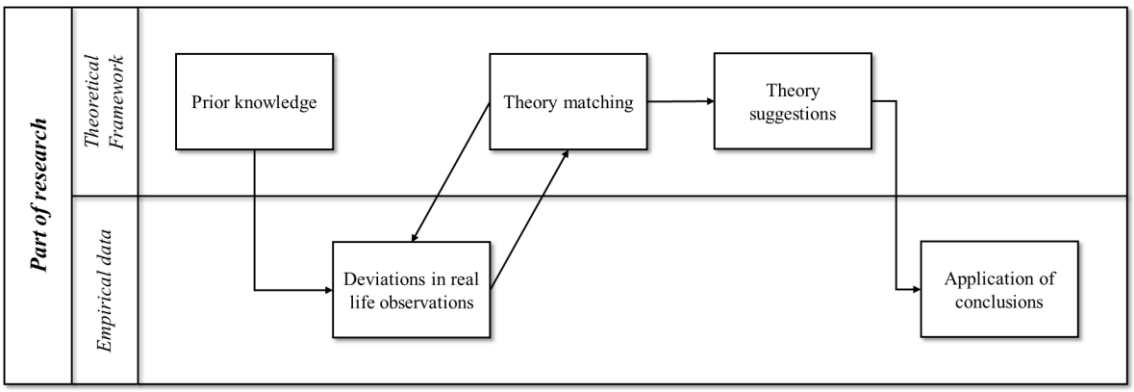


Figure 14: *Abductive research approach: Source adapted from: Kovacs & Spens (2005)*

3.2.1 Primary data

The primary data is an original data source which is collected by the researcher for the first time. There are different ways in which primary data can be collected, but, out of these, the most popular and important ones are observations, interviews, schedules, case studies, self-administered surveys and questionnaires, etcetera (Kothari, 2004).

Observations

The observation method is a type of data collection method where the knowledge of the researched topic is gathered by making observations of things around the topic. This sort of method can be considered as a scientific tool when observation contributes to a formulated research purpose and is well planned and recorded. There are several advantages to observation method i.e. with the help of observation method, the information is looked for by the researcher without asking any of the respondents which indeed explains the independence of this method with respect to the willingness of the respondent to respond. Secondly, the observation method eliminated the subjective bias (Kothari, 2004).

In this thesis, observation method was deployed to understand the S&OE process for the SKF's industrial market. The observations were made from the headquarters in Gothenburg with virtual conducted S&OE meetings by a specific sales region. The meetings were observed to understand the aspects which are discussed, the inputs to the S&OE meeting and outputs or decisions taken with respect to S&OE. In addition to that, observation methods also enabled to get an overview as to what is being contributed by different stakeholders. The agenda for S&OE meetings did not have major differences but it was also customized based on the complexities and types of deviations each sales unit was facing. Lastly, the majority of the meetings were recorded and analyzed in detail to have a deeper understanding of the meetings which took place and follow-up questions were asked during the interviews with subject matter experts as explained in the next section.

Interviews

Interview is one of the commonly used methods for data collection which involves the medium of communication between two persons (Kothari, 2004). There are several types of interviews stated in literature such as face to face interviews, telephonic interviews, structured interviews, semi structured interviews, etcetera. As this research is based on a qualitative study, interview is an ideal method for data collection.

Semi structured interview is a popular data collection method used because of its versatility, flexibility, and easiness of data collection. In this method, the interviewer can improvise the follow-up questions based on interviewee's response. This also enables the interviewer to gain a deeper understanding since the question can be adapted based on the response from the interviewee. But in order to conduct a semi structured interview, there needs to be some level of research done prior to the interview. Hence the questions need to be formulated before the interview (Kallio et al., 2016). Another type of interview which was conducted are the unstructured interviews. It is a type of interview where there is no defined agenda or questions set

before the interview, but there are certain topics in mind which the interviewer wishes to cover during the interview.

Both unstructured and semi-structured interviews were conducted virtually using the organization's communication application "Microsoft teams" in order to gather primary data. The stakeholders with whom these interviews are conducted is listed in Table 6. There are two main purposes for conducting the unstructured interview. First, the intention was to gather general information about the company in terms of their organization, their supply chain, the various kinds of products they manufacture, their customers and their market companies placed globally. Second, the domain of this study is relatively new, therefore, it was necessary to dig in depth on the initiation and the implementation of the S&OE process at SKF, hence the unstructured interview is used to acknowledge the process and workings of the organization. Post the unstructured interviews, semi-structured interviews were conducted. The purpose of the semi-structured interview was to ask more specific questions based on the unstructured interview. The questions asked in the semi-structured interview also included follow-up questions in order to narrow down the description of answers. Two of the three research questions i.e. research questions one and two, are primarily constructed based on the information from the unstructured interview. The third research question was constructed based on the purpose of this thesis. The questions to the semi-structured interviews are listed in the appendix B.

There was only one unstructured interview conducted face to face with the S&OP owner of SKF. This is because the interviewee was physically available at the SKF headquarters in Gothenburg, where this thesis is conducted. This interview was done in order to determine how the S&OP for the automotive market was mature and S&OP for the industrial market not existing.

At SKF, interviews were conducted with the Global planning and Demand management team who are responsible for the implementation of the S&OE process. The team were considered as subject matter experts for the S&OE process who were also consulted for decision making and they were also part of performance management of S&OE process. The list of interviewees who participated is shown in the Table 6. The data gathered from the interviews were used to understand the S&OE process. Among these interviewees, some were interviewed 3-4 times while others were interviewed more than that.

Department and position	Purpose of interview	Type
Demand and Network Manager	Weekly meetings conducted for clarifying questions related to the S&OE process and understanding different aspects of S&OE learnt from S&OE meetings.	Virtual
Manager of Global planning and demand management	SKF IT infrastructure, KPIs used for S&OE process, background of S&OE process, and the implementation of S&OE process.	Virtual
Demand chain project manager and business analyst	S&OE process with a special focus on understanding the S&OE process being implemented on APAC region, roles and responsibilities of Operational Demand manager and KPIs used in S&OE process. Also, to understand how the different KPIs are used by the stakeholders involved in the S&OE process and RACI matrix for the current scenario.	Virtual
Logistics &Demand Chain Network Analyst and Project	Network management, network planning, dashboards and customer demand segmentation.	Face to face at SKF Gothenburg headquarters
Logistics and demand chain / Sales and operations planning	S&OP process and the complexities involved in the implementation of S&OP in SKF industrial markets.	Face to face at SKF Gothenburg headquarters and Virtual

Deployment and planning expert	Introduction to SKFs supply chain and the integrated planning project which is being implemented at SKF.	Face to face at SKF Gothenburg headquarters

Table 6: *List of interviewees with purpose of interview and location. Source: Author's contribution.*

3.2.2 Secondary data

According to Kothari (2004), secondary data refers to the data that already exists i.e. a set of data that has been gathered and assessed by someone else. It is important to consider that the data gathered might be with a focus on obtaining other objectives and not relating to the purpose of this particular thesis. Therefore, it is to be taken into consideration that it may not be comprehensive, and it can be biased. However, we emphasize on the literature study in the beginning of this thesis as the theoretical framework was developed.

Literature and frameworks

For this thesis, academic works on the topic of sales and operations execution is very scarce. Hence, many other sources of information such as consulting groups, posts in blogs, articles from Gartner and Oliver Wight and even webinars were used to build the theoretical framework. In particular, we relied mostly on one journal that was conducted by Carvalho (2018) work with the topic "The Intermediate Link in Planning: A multiple case-study of the Sales and Operations Execution process". Carvalho (2018) was used as a stance to build more knowledge on the topic of S&OE as this journal formalizes an S&OE model using four case studies across various industries. With this knowledge, we progressed to find more relevant sources that could defend this thesis. It is to be noted that term of S&OE is also known as demand execution or demand control and closely related to the principle of MPS, hence, the search for literature on this topic had expanded to these terms which primarily lead to a webinar conducted by Lindsey (2019) from the Oliver and Wight consultation company. Therefore, most of the secondary data that is used in this paper is considering the terms of S&OE, demand execution and demand control. Also, the literature on sales and operations planning from Grymson and Pyke (2007) is also considered to build the maturity framework of S&OE.

SKF data

SKF group and all other departments present within the supply chain use an online platform to document and share information. With access to SKF internal documents, we learnt more about

the organization structure, tools and business process used. These documents also helped us understand how SKF portrays the purpose of S&OE within the organization of Demand management.

3.3 Model of analysis

To be able to visualize and understand the methodology adopted to answer the research question and how the research work was performed, a model of analysis is presented for each research question in the next sections.

3.3.1 Research question 1

The research question 1 began by understanding the S&OE process from the existing literature consisting of whitepapers from different consultancies, webinars, SKF's workshop material, master thesis papers and journals relating to the S&OE process. This was done because there was lack of academic literature regarding the S&OE process. Hence, by reviewing all these literatures, the characteristics were defined, and a theoretical framework was finalized to develop empirical data of the case company. Then, the finalized characteristics of the S&OE process at SKF is compared against the framework developed to arrive at conclusions for research question 1.

3.3.2 Research question 2

In order to answer research question two, firstly, literature on roles and responsibilities matrix with respect to project management is reviewed which then required to understand the activities and decisions made. Hence, workflow was developed to understand the activities done and decisions made by each stakeholder. Keeping this in mind, both primary and secondary data were collected from SKF to build a business process workflow which is further analyzed to develop RACI matrix and then the role of Operational demand manager is understood. Based on the existing theory of demand execution manager, facilitator, or responsible person for S&OE process according to Holmes (2015) & Lindsey (2019) was explored. Then, the roles and responsibilities of demand execution manager is explored among different companies. These are then reviewed for how the role of demand execution manager is set, the roles and responsibilities are altered. Once these roles and responsibilities of Operational demand manager are set, it is then reviewed against SKF subject matter experts to get a more practical standpoint.

3.3.3 Research question 3

The research question 3 began with the idea of theoretical contribution towards S&OE maturity frameworks. Here, first the maturity model was selected to adapt based on the criteria's set for selection of maturity model and on the number of citations of that specific framework finalized. Once the maturity model was finalized, the context of the company was determined by understanding different contextual factors. In the next stage, S&OE maturity model was developed from, firstly, understanding and knowledge of SKF's S&OE process background and implementation along with the experience gained from participation in S&OE meetings and interviews of subject matter experts. Secondly, knowledge of Grimson & Pyke (2007) S&OP maturity framework and, thirdly, knowledge gained from exploration of research question 1. The developed S&OE maturity framework is used to assess SKF's S&OE maturity based on which the recommendations are proposed.

3.4 Research quality criteria

According to Bell et al. (2019), reliability of the research can be segregated into external and internal reliability. External reliability is the ability on which a study can be replicated and provide the same or similar results when the research is conducted again. Considering this case study at SKF the observations that were made were non structured i.e. there was no template used for observation when attending the S&OE meetings across different regions. Moreover, the organization at SKF is changing continuously with new technologies and processes being implemented during the thesis period. Therefore, researchers with a similar background of supply chain management could end up with different results than this research.

According to Bell et al. (2019), the internal reliability explains the consistency of the results obtained. The interviews that were conducted are semi-structured interviews where follow up questions were asked. A different pair of researchers asking the same questions could deliver similar results, but it would also primarily depend on the follow up questions asked where answers from participants could vary in some areas. But, we had a good understanding of the S&OE process as there were many interviews and many observations of the S&OE meetings conducted in various regions which provided a good discussion among us to arrive at mutual decision and conclusion. Other researchers would also obtain similar results when attending numerous interviews and meetings. An important factor to consider is, some regions of SKF were at the initial phase of implementation for the S&OE process while some regions already had mature S&OE process such as SEA (south east Asia) for the former and USA for the latter. Therefore, observations done by us could vary when repeated by other researchers as the S&OE process

would have been more matured globally. Hence, questions were asked, and observations done by us are mostly related to the implementation of the S&OE process, therefore, other researchers who wish to repeat this research would mostly strategize to conduct this thesis considering a more mature face of the S&OE process at SKF. However, a similar research conducted with other researchers in the same context of the company would deliver a similar result.

Validity of research represents the extent to which the results or the conclusion drawn from the research is accurate (Adams et al., 2014). For this research we have considered two types of validity, namely, internal validity and external validity which are mentioned below.

Internal validity is defined as the extent to which the observed results represent the truth in the population we are studying. The internal validity of the study can be increased by ensuring careful study planning and adequate quality control and implementation strategies-including data collection, data analysis, and sample size (Adams et al., 2014). Hence, the internal validity can be related to the quality of qualitative research performed, i.e. how well the data is extracted through inductive research from primary and secondary data. With respect to primary data, the subject matter experts explained in Table 6 were carefully selected and interviewed which enabled an increase in internal validity. But primary data could be improved by interviewing other stakeholders such as sales and Operational demand manager, but we had difficulties in aligning the meeting with them due to COVID-19.

External validity is defined as the ability of the results obtained from the study to be generalized to other contexts (Adams et al., 2014). With respect to the final findings of the research, it is best suited as a solution for SKFs context. Hence, the external validity of this research is low and is inferior to internal validity. But, some of the findings of the research might be valid for companies with similar contexts as SKF.

4 Empirical Data

This chapter portrays the results gathered from primary and secondary data regarding the S&OE process at SKF. This chapter will describe the current "as-is" situation at SKF, with respect to its supply chain, organization structure, product offerings and the context of S&OE. More specifics about the S&OE process occurring at SKF will be presented along with S&OE maturity assessment. Thereafter, there is empirical data on the workflow of S&OE process, roles and responsibilities of the Operational demand manager and the demand planning maturity at SKF.

4.2 Description of SKF supply chain

This section will describe SKF's context in sales and operations execution at SKF. First a description of SKF's transitioning to demand driven supply chain will be given which will then be followed by the internal and external context of SKF. The Figure 15 presents the previous supply chain of SKF. Most of SKF's operations have been organized locally wherein the planners only focused on local operations or warehouses (WH) and attending to customers within their specified region. There would be one local planner or one team per node each handling different assortments. The local inventories were replenished by regional WH and the regional WH would be replenished by the factory WH. Therefore, it can be understood that each echelon of this multi-tier organization was planned only focusing on optimizing locally conducted operations. Hence, a few disadvantages were noticed such as planning based on local optimizations limited the alignment of regional forecasts which led to various planning methods and parameters to be considered. And importantly, SKF was bringing upon themselves fluctuation in their supply chain.

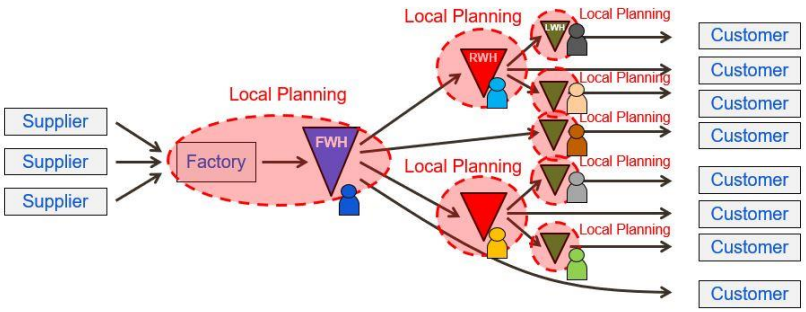


Figure 15: *SKF supply chain before integrated planning. Source: SKF*

With lacking benefits from this typology of supply chain SKF decided to create a global planning approach i.e. to implement integrated planning with a design principle that global optimum beats local optima. With integrated planning SKF can plan globally where the plans will be more effective and efficient i.e. the organization is able to plan dependent flows together, planning from one location all inter-connected end to end activities that relate to one item. SKF saw possibilities to increase efficiency in their planning process by having a high level of automation across the demand chain and interfering only when required to handle problems. SKF currently uses global planners who are responsible for each product line which relates to having one global forecast, one specific planning method, management of inventory globally for the product and overall having only one responsibility. It is also the responsibility of the global planner to meet customer service targets. Management at SKF state that this is a better planning method than the previous one as this avoids local planners focusing only on local regions and having several independent organizations focusing only on internal targets. Figure 16 below shows the process of integrated planning at SKF.

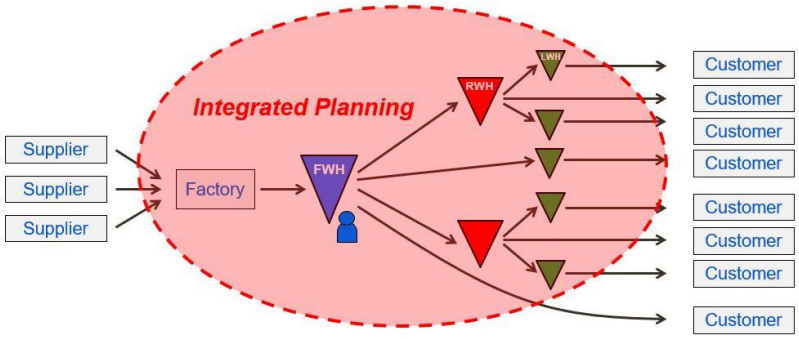


Figure 16: *SKF supply chain with integrated planning. Source: SKF*

4.3 SKF S&OE context

4.3.1 Internal Context

Organization

At present the company's operation is split into two markets: Industrial Market as one and Automotive & Aerospace as the other. The Figure 17 below depicts the organization chart of SKF. The industrial market primarily deals with managing the total life cycle of customers and assets and provides a range of products, services and solutions to OEMS and end customers among different industries. The automotive market provides bearings for OEMs such as car truck manufacturers. The company also provides products and services for the vehicle service market

i.e. aftermarket parts. It similarly delivers a range of products and services for the aviation industry.

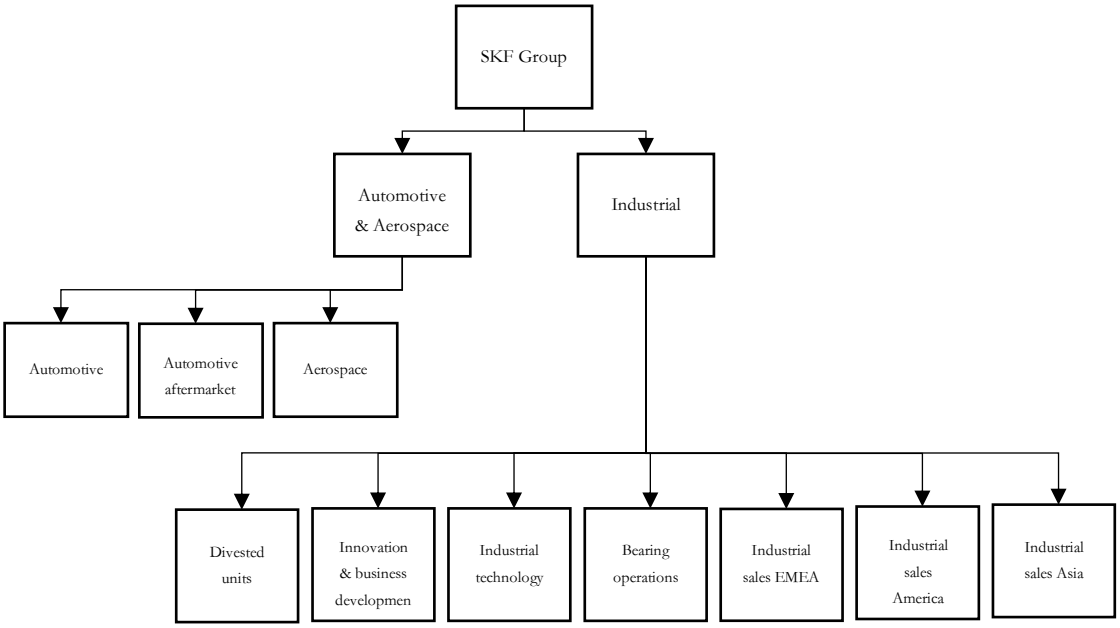


***Figure 17**: SKF Organizational chart. Source: SKF*

Since this project is conducted within the industrial market, more company details will be given about this specific market. The Industrial market is further broken down into sales and bearing operations. With respect to sales the company has three major focus areas globally; Asia, Europe, and America. About bearing operations, it primarily deals in the manufacturing of traditional bearings which are still a high runner. In SKF, the factories that are producing for the industrial market comes under bearing operations. The products manufactured in these factories can also be a part of automotive products, but it is only considered to be a part of industrial if that specific product results in a sale greater than 50 percent. The reason for SKF to split its industrial sectors to three major markets is due to its large product portfolio and volume. The industrial market also has "industrial technologies" which is related to as "special business" wherein SKF has acquired companies in the last 10 years which has expanded the company's product portfolio. Hence, they not only produce traditional products but also products related to technological advancement such as magnetic bearing, copper bearings, marine bearings etcetera.

In order to match demand and supply SKF deployed a S&OP process globally focusing on both Automotive & aerospace and Industrial. At present the S&OP process for the automotive & aerospace market is well-established and is at a stage four maturity level in Gartner's S&OP model. The reason for automotive & aerospace markets to attain a high level of maturity is mainly because it is easier to forecast demand than industrial customers as there are orders placed

primarily from major OEM customers. Whereas the S&OP process for the industrial market, which was initiated failed, the reason being, the demand is based from large customer groups with varying demand in large quantities due to large number of product families and internal organizational complexity. For e.g. there are too many products and many customer ID with approximately 100,000 order-lines per day. Hence, it is unreliable to make sales organizations forecast the demand. When it was difficult to synchronize demand and supply, factories developed their own forecast and started to produce without a link to demand from sales.

Therefore, in order to bring the demand and supply closer to synchronization SKF initiated demand management. Demand management focuses primarily on synchronization of demand and supply where a process known as S&OE is introduced. According to the management of SKF the S&OE process is a demand "deviation handling process". SKF began implementing the S&OE process which is ultimately about identifying and controlling the inflow of abnormal demand into the SKF supply chain. At present an S&OE is in place for the organization, but, only for selected international markets. Therefore, this thesis will focus on studying the current S&OE process, evaluate KPIs and analyze variations in demand to determine if the roles and responsibilities within the organization are correctly set.

Product Complexity

As it can be observed from the above Figure 18 the industrial sector serves many markets and hence has a large product portfolio which contributes to a large part of SKFs sales. The industrial market has 100,000 thousand order lines per day which relate to the same amount of customer IDs generated. Due to this large product portfolios and enormous volume there is intense complexity in dealing with manufacturing products and serving customers. Also, With SKF's expansion in assortments to many industries worldwide it gives the organization an advantage to gain a large market share.

4.3.2 External context

The context in which SKF operates in the Industrial sector makes collecting customer demand unique. As SKF serves thousands of customers globally and across various industries, the way in which demand is obtained from customers are in a numerous way i.e. EDI's, WEB Shop customer links, schedule handling customers, E-mails, and CQM/P&Q quotation. Demand from EDI's, Web Shop customer links, emails- and phone calls are orders which are manufactured only after the order is placed. It is important to note that demand obtained from the methods mentioned above are inputs to the SKF's statistical forecasting tool SO99 via customer order handling system. This forecasting tool forecasts demand based on the shipment date of previous sales and

displays new forecasts for the upcoming horizon. Hence, the entire manufacturing of products depends on the output of statistical forecasting tool. SKF also has scheduled handling customers where for certain customers SKF consistently produces a certain quantity and item based upon the contract signed with the customer. SKF also produces new products when requested by customers. A separate tool is used to develop and manage new products; in this tool specific requirements are given by the customer to produce a unique product depending on customer demand. Therefore, with different business models that SKF produces in make to stock, make to order and Engineer to order stocking strategies.

It is also important to note that customers do give unpredictable demand in terms of quantity and delivery time which is not planned or forecasted by SKF. SKF calls this demand "Prompt order" placed by customers. Prompt orders are defined as when customer requested delivery time is less than the time required to replenish the item for delivery of that customer. Orders that are fulfilled and delivered to customers on time are called "termed orders". Hence, SKF serving a wide range of customers attend to unpredicted demands daily on SKU level.

Downstream

Internal distribution network of SKF is represented from Figure 12 where it only consists of a factory warehouse (FWH), regional warehouse and local warehouse. Almost 60 percent of the sales that occur in the industrial sector are through distributors that are spread across the globe. Distributors are an end-user interface of the SKF supply chain; therefore, the administration only knows the product items that are manufactured but lack specific customer details on the consumption of products when sold through distributors.

SKF also handles delivering products from each respective warehouse differently. For e.g., if the order is placed by a customer who is close to the respective local warehouse, the customer is served from the closest warehouse location. But, if an order from a customer in quantity wise is larger than the quantity which can be delivered from a local or regional warehouse, the customer is served directly from the factory warehouse.

SKF's supply chain uses transportation methods of sea, road, and air, but customer requirements are prioritized and sent accordingly using a cost-effective transportation method. In case of backorders SKF fulfills the backorders in the next shipment to that same customer with the same transportation method. To get accurate customer data SKF collaborates with major industrial customers in order to gather demand information on an aggregated level to forecast and produce for a longer horizon for that customer.

4.4 Sales & Operations Execution at SKF

At SKF, the S&OE process is a part of demand management which began rolling out in the last quarter of 2018 and is now implemented in all regions of SKF. The S&OE process has been set up with a focus on the customer and demand side of the full E2E supply chain, including short term planning, demand monitoring and abnormal demand handling in combination with strategic planning. Also, with integrated planning being rolled out parallelly there is a need for a structured market intelligence from the customer side to flow to the supply side where this activity is the main contribution of S&OE process at SKF. The main motivation for the kickoff of the S&OE process at SKF was supported by the fact that the demand side issues were contributing 50% of availability failures and 25 % of total unhealthy distribution stock. There were many root causes for the demand side issues which were identified by SKF which includes the reduction of customer demands, order postponements, order cancellation, order rebooking's etcetera depending on a sales region. At SKF, S&OE is mainly about identifying and controlling the inflow of abnormal demand into the SKF supply chain. This is done with the help of a cross functional process between the main stakeholder's Demand manager, Customer service / Sales and the global planner. The S&OE process is a part of a sales organization where the decisions and action plans are developed by the Demand manager/Sales.

4.4.1 S&OE horizon

At SKF, the planning horizon for the S&OE process is defined to be in 12 weeks to 3 months as shown in Figure 18. As the defined scope of planning horizon is shorter, the S&OE team and the stakeholders are equipped to identify the deviations happening in this planning horizon and these deviations are addressed during the weekly cadence meeting. When looking at the volume from the capacity perspective, at SKF, the S&OE process considers volume as fixed and there is some flexibility in terms of timing. For instance, an example when volume is fixed, and timing is flexible is how to make use of an existing stock and how well the stocks can be allocated.

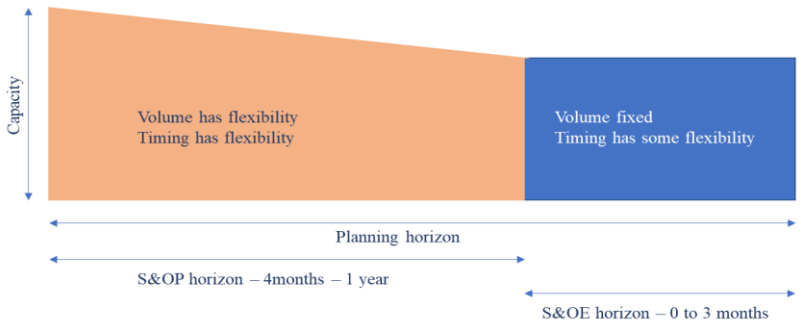


Figure 18: *S&OE planning horizon. Source: Author's contribution*

4.4.2 Data hierarchies

The systematic organization of data is done as usual in the hierarchical form. As presented in Figure 19, SKF has placed the S&OE process lower in the date hierarchy which means that the S&OE process requires high product granularity of data i.e. SKU location level data. This level of product granularity data enables the S&OE team and the stakeholders involved to have the access to the right level of planning data. With respect to time, the S&OE process is conducted with a weekly cadence as the shorter time horizons contribute to enhancement of the ability to execute the plan or decisions taken in the S&OE process.

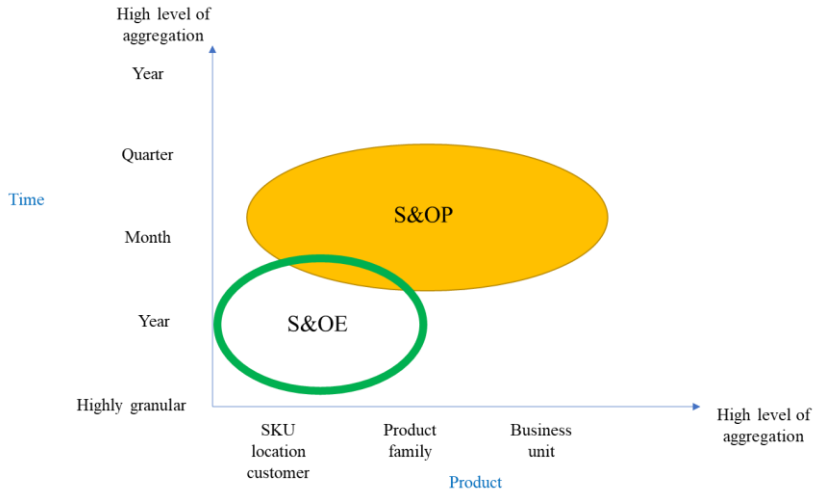


Figure 19: *Data hierarchies set at SKF. Source: Author's contribution*

4.4.3 S&OE inputs and outputs

The inputs to the S&OE meeting were divided into demand and supply inputs. The demand inputs includes significant forecast deviation on item level, significant cancellations/postponements, overdue shipments, top x items with abnormal high or low demand according to forecasting system, significant items which are not routed as per the default network, open DMIs (Demand management inquiries) and demand supply review on contracted stock and supply agreements. The inputs from the supply side could be the reasons for rebooking's and capacity alignment issues highlighted in S&OP. According to Chainalytics (2019), the outputs are the alerts, decisions, or plans. At SKF, the outputs are communicated to the supply who in turn makes decisions to remove peaks of abnormal demand. The outputs to sales could be adjustments on orderbook or liaising with customers for further information regarding their orders. Lastly, the output of the S&OE process could be the demand control report which documents the deviations identified during the S&OE process. The inputs and outputs are shown in Figure 20.

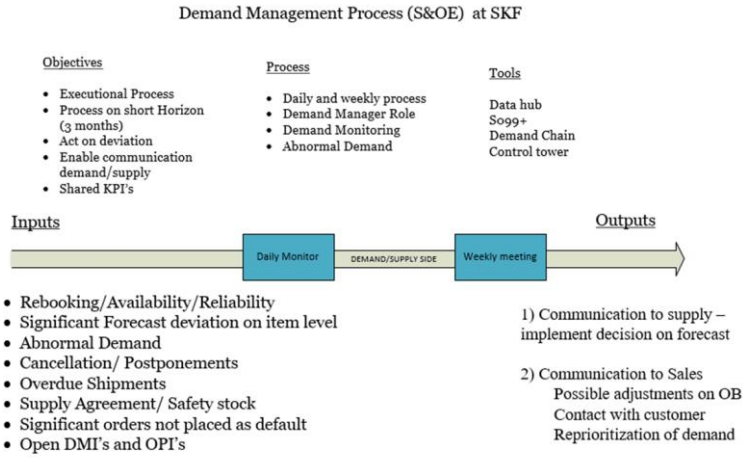


Figure 20: Inputs and Outputs. Source adapted from SKF.

4.4.4 Implementation of S&OE

As explained earlier, the business process at SKF for the industrial sector that is currently present is the S&OE process. The S&OE process was initially started as a pilot project for the North American market wherein the project later expanded to Turkey as a successor. At present, now having implemented the S&OE process to all markets globally, SKF has developed an implementation methodology which will be explained in Figure 21.

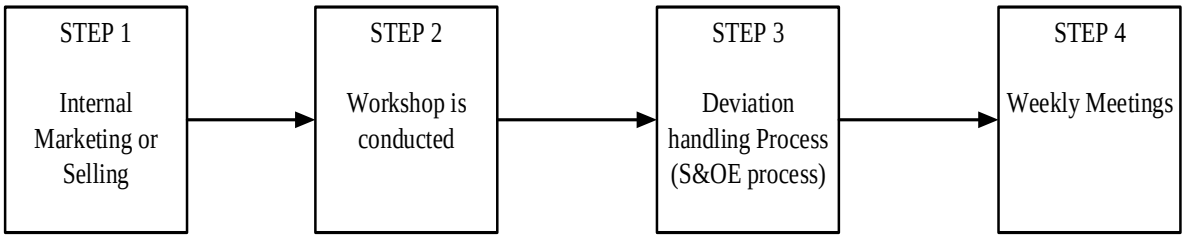


***Figure 21**: Implementation of S&OE process. Source: Author's contribution.*

Step 1 – Internal marketing or selling

In the first step, the top executives of SKF carefully analyze each market globally to determine which market finds challenges to meeting supply / demand balance. Once the market has been targeted, the management of SKF communicates with local sales organizations to review extreme examples such as abnormal demand, unsatisfied customers, late delivery etcetera that has been a challenge for them to deal with locally. The top management then markets and sells the idea of S&OE as a process or a tool that can be used to manage or overcome the listed challenges. With an agreement from local sales a workshop is conducted.

Step 2 – Conducting workshop

In this step, by conducting a workshop, the top management of SKF enlightens local organizations about S&OE and its benefits. The top management also recruits decision makers for that market as it is important to have one decision maker from each unit globally. The decision makers could be managing director of sales, a shareholder or anyone that holds complete knowledge of SKF demand and products. Also, as sales lack prior knowledge about SKF supply chain, the top management in this step will also take the opportunity to explain to local sales employees about the functioning of SKF supply chain. This is for sales to clearly understand the operational activities which lie behind once an order is placed from a customer.

Step 3 – Deviation handling process

After the workshop is conducted, a discussion is created between the local sales employees and the top management where both discuss large deviations in demand with respect to a specific market. Acknowledging that different units worldwide will have different priorities, the top management together with the local sales teams investigate on daily demands and then choose key performance indicators that best define problems of that market. The top management then indicates to the sales team that these KPIs needs to be handled through the S&OE process i.e. a deviation handling process. The structure and role of weekly meetings will also be described wherein the weekly meetings will contribute to monitoring and handling KPIs with complete collaboration from employees of different functional departments.

Step 4 – Weekly meeting

Sales and operations execution weekly meetings are conducted among sales, customer service, inventory management and business controllers that proactively discuss on attending to performance indicators and finding better ways to manage unpredicted demand. It is also important to note that executives will attend these meetings for the first couple months to assist employees on tools and technology that will be used in this process and to answer the doubts that arise from S&OE meetings. The decisions in the meetings mostly correspond to attending KPIs that measure effectiveness and efficiency of the S&OE process and managing forecasts for the current and future horizons.

4.5 Roles and responsibilities

4.5.1 Understanding the business process workflow

As already explained in the theoretical framework, the usage of modelling language enables to properly represent the steps of the process. The modelling of the S&OE process is represented in

Figure 22 which will be explained below as per the swim lane diagram. Each swimlane signifies the activities done by the S&OE team and the stakeholders involved, namely the Operational demand manager, customer service/sales, global planner and subject matter experts. The use of swim lane diagrams enables to clearly define the roles and responsibilities of each stakeholder involved in the S&OE process. This also supports in development of the RACI matrix among them stakeholders and understanding the roles and responsibilities of Operational demand manager, the facilitator of S&OE process. The activities in S&OE is not in sequence i.e. it is non-linear, and some activities can happen parallelly.

The BPMN diagram from Figure 22 will be explained with respect to participants of the S&OE process enabling a clear understanding of the activities performed in the S&OE process which is as explained below. Also, under the heading of "scenario of abnormal high demand" there is an example of one scenario to clearly understand the activities done in S&OE when there is abnormal high demand from the customers.

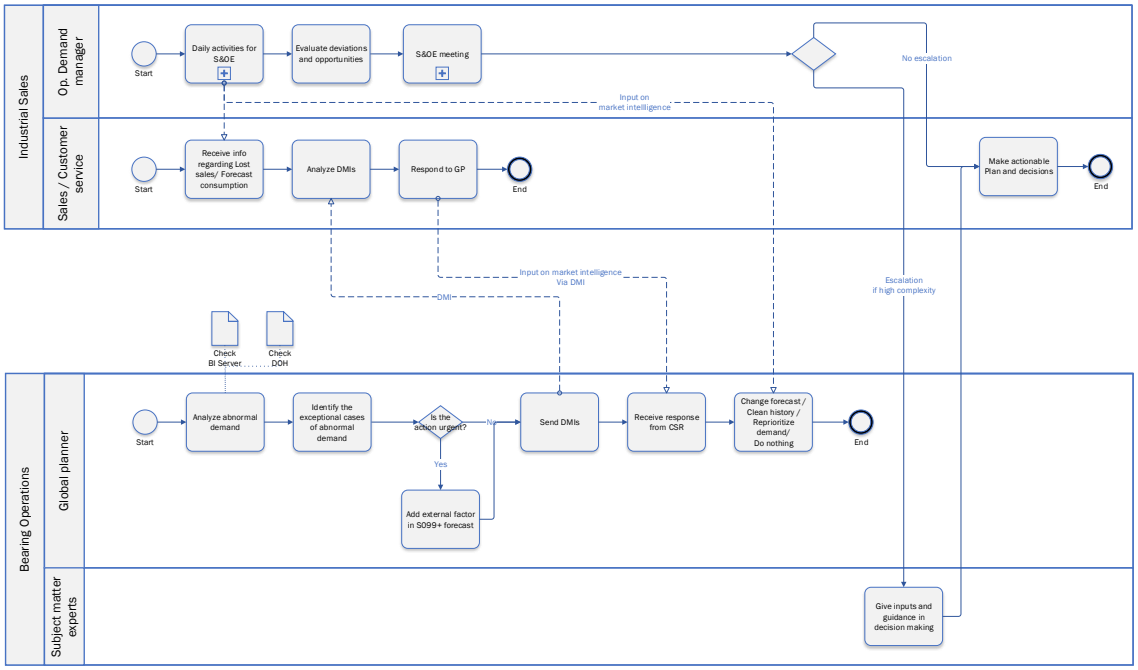


Figure 23: *SKF Current states S&OE BPMM. Source: Author's contribution.*

Operational demand manager

The S&OE process of Operational demand manager begins with daily/weekly activities performed by the Operational demand manager. At SKF, the frequency of activities is decided to be in daily or weekly depending on whether the integrated planning project is implemented for

that sales region. The daily/weekly activities relating to S&OE done by Operational demand manager are explained in Figure 23 which consists of the following:

- Analyzing availability failure
- Analyzing reliability failure
- Analyzing the quality of inventory
- Analyzing the re-booking/cancellations/postponements made by the customer.
- Analyzing the order book to check the number of overdue orders from the customer order book and number of orders which are on hold.

By analyzing the above mentioned KPIs, the key deviations and opportunities are identified and is recorded for discussion during the S&OE meeting.

Global planners

Global planners check the abnormal demand received from the forecasting system or business intelligence server or delivery order handling system and identify the exceptional high or low abnormal demand received from the customer. This exceptional high or low abnormal demand is inquired using DMI tool with the customer service or sales. Once the feedback is received on abnormal demand from the sales/customer service, the global planner removes the peaks from the forecasting system, which indeed contributes to stabilization or normalization of statistical forecast. About deciding as to what peaks in customer demand needs to be removed from the forecasting system is based on different factors. For instance, if a customer agrees to share the forecast for consecutive months, then the global planner decides not to remove the peaks from the forecasting system. It could also be a case when an onetime abnormal demand from the customer is received and the global planner decides to remove the peak abnormal demand received.

Decision maker

The decision maker is part of a sales organization who is given authority to make decisions related to the S&OE process. He/ she has a good knowledge of all the demand related issues and is familiar with the daily operations related to demand side.

Sales/Customer service

The sales/customer service receive the abnormal demand inquiries through demand management inquiry (DMI) tool. DMI is a global online workflow established to send inquiries and receive answers between planners from all warehouses & customer service globally. Some of the abnormal demand creating peaks in the forecast are highlighted by the global planner or Operational demand managers to the customer service who then investigates with the customer

and responds back with information from the customer to the Global planners/ Operational demand managers.

Subject matter experts

Subject matter experts (SME) are individuals with good knowledge in demand management, sales and operations planning and other aspects related to S&OE. He/she has good knowledge in the overall business process at SKF including both and supply side. As SKF have decided to have inbuilt S&OE process, then SME was responsible for the implementation of the S&OE process throughout the company. In S&OE context, SME gives input to support decision-making when actions are escalated.

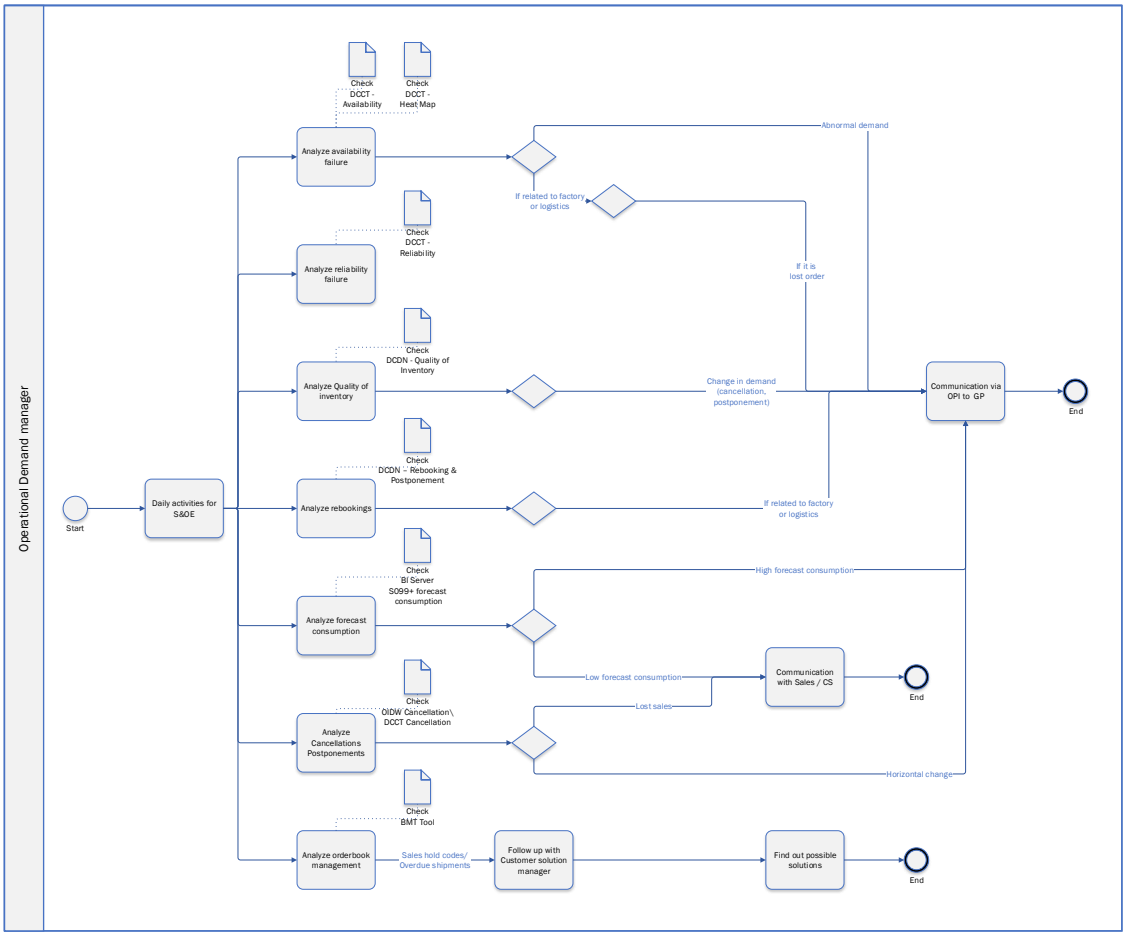


Figure 22: *Daily activities of Operational demand manager in S&OE process. Source: Author's contribution*

Scenario of abnormal high demand

Considering the scenario where there is abnormal high demand from a customer. Since, SKF is currently using a statistical forecasting system to forecast demand in the industrial market. Now, when this abnormal high order is received, the Operational demand manager/ global planner

highlights this abnormal demand to customer service representatives through DMI. The customer service representative (CSR)then investigates with that specific customer as to whether there will be any future order from that customer, or if it is a one-time order. If its one-time order, this abnormal order is removed from the forecasting system. When considering a case where the customer gives information related to future orders. The CSR incorporates that information in the Demand Management Inquiry (DMI) which is then incorporated into the forecasting system by the Global planner or Operational demand manager.

4.5.2 Roles and responsibilities of the S&OE team

At SKF, it is the Operational demand manager who is dedicated to perform the S&OE tasks and activities. He may or may not be assisted by demand planners depending on the complexity of the sales region. About the roles and responsibilities, firstly, Operational demand manager should have a basic understanding of the demand and supply process which includes the understanding of different ERP systems involved in the demand and supply process. Secondly, his/ her main responsibility should be the management of abnormal demand which includes demand monitoring and analysis of actual demand. Based on this analysis, Operational demand manager highlights the key availability failures caused by the abnormal demand to customer service representatives/sales. Thirdly, the Operational demand manager should understand the forecasting process and forecast consumption so that he/she can provide inputs to the supply side. As S&OE process itself is a collaboration between demand (Sales / Customer service representative / Operational demand manager) and supply (Global planner / Local planner), Operational demand manager should be able to facilitate common understanding among different stakeholders. Lastly, it is also included to manage and give feedback on NAR, supply agreements and contract stocks.

4.6 S&OE Maturity at SKF

This section of the report explains how SKF is currently working with S&OE which was initiated within demand management. The purpose of this section is to use the dimensions of the Grimson & Pyke (2007), maturity model and answer the research question three to provide an empirical data which will be analyzed in the next chapter with the S&OE maturity model that is developed.

4.6.1 Meetings and collaboration

At SKF, globally S&OE meetings with a weekly cadence which involves stakeholders from different departments who actively participate in managing current and past deviations in demand.

At SKF, globally S&OE meetings are conducted on a weekly basis which involves stakeholders from different departments who actively participate in managing current and past deviations in demand. In specific, stakeholders including customer service, Operational demand manager, business controller and a decision maker from sales are always present in these meetings. The meetings also consist of subject matter experts who assist in solving sophisticated problems that may arise during these meetings. The weekly meetings are always formal and scheduled based on the availability of stakeholders.

S&OE meetings at SKF are given one of the highest priorities and are well-planned by the Operational demand manager. The Operational demand manager is the owner of the S&OE meeting who takes the responsibility in gathering information on weekly status and organizing the information and presenting it in the beginning of each meeting. This provides a brief overview to the participants involved on what will be discussed in the meetings i.e. agenda of the meeting. Hence, the agenda of the S&OE meetings would be to have an action review from the previous week, discuss on SKUs that have affected the KPIs negatively, significant deviations of orders that have been noticed from the past week and discuss on the necessary actions or decisions required to reduce these effects. The objectives of the S&OE meetings are primarily to have a control on the short-term abnormal demand flowing in and match it accordingly with supply, improve demand planning, service level, stock level and communication through the whole chain to be more efficient and effective. SKF also takes the opportunity to collaborate with strategic external customers in order to integrate the demand data to run smoother operations in their supply chain. While there are many aspects taken into consideration apart from what is explained above it is observed that the S&OE meetings primarily discuss what has happened in the past and how those deviations or failures could be rectified. Hence, the meetings at SKF are constantly on firefighting mode that causes expedites of raw materials, higher frequency in rescheduling orders and a raise in logistics cost to live up to customer expectations. Discussion in the meetings does not look into the near-term future to plan ahead on how future deviation or opportunities could be handled or obtained. The S&OE meeting session also discusses the customer orderbook and KPI failure that has occurred for the current and the past week. Each of the KPIs are analyzed on SKU level to determine the root cause among others involved. Forecast retrieved and analyzed by the Operational demand managers from the statistical forecasting tool (SO99) is also very crucial, hence, the Operational demand manager gathers input from decision maker on how to normalize the peak of forecasts for a specific horizon when an abnormal demand flows in.

4.6.2 Organization

At SKF, S&OE is an important process and it is among other functions i.e. all other departments have acknowledged the benefits of S&OE and the process has a leader who is considered to be the owner (Carvalho, 2018). The process also has a decision maker from sales who makes the final decisions at the end of weekly S&OE meetings. The decision maker only takes decisions for issues that are brought up to the weekly S&OE meeting and a final call at the end of every meeting and other decisions are made solely by the respective managers working in their department. There is a dedicated S&OE team under demand management i.e. Operational demand manager who is responsible for tasks under the S&OE process which is explained in detail in roles and responsibilities section 4.3 in this report. Among the stakeholder's business controllers take part in the S&OE meetings in case there are any inventory adjustments to be made. Also, in some regions, the warehouse manager of a specific sales region also participates to make any decisions related to inventory.

By now, it is understood that SKF has taken S&OE meetings seriously and have prioritized these meetings. Hence, these meetings are considered highly relevant to handle deviations in a systematic manner. The significance of these meetings is acknowledged by top executives and managers at SKF. The level of understanding regarding the S&OE process is different for the stakeholders with respect to forecasting. For instance, forecasting which is done on item level with respect to a specific region may be useful to supply planners but may not be that useful to sales/customer service representatives as they would prefer forecasting done on customer level.

4.6.3 Measurements

At SKF, the S&OE process uses different KPIs to control the overall outcome of the business. These KPIs serve the purpose in conducting the S&OE process in an efficient and an effective manner when monitored and taken timely decisions. As aforementioned in literature review; KPIs are used to measure the effectiveness of the business process used in the organization. For the S&OE process at SKF the KPIs used are stock level and bad stock, availability failure, reliability failure, forecast accuracy, rebooking, postponement and cancellation order book management which includes order book on hold and order book on hold for more than 3 months. These KPIs will be defined and explained on how each of them affects the S&OE process at SKF S&OE process:

- Availability failure measures if the first requested date from the customer order is accepted or not in terms of quantity and time. For e.g., if a customer wants the pieces delivered tomorrow from SKF once the order is placed, SKF checks accordingly in their business

function of available to promise to cross verify if the requested order could be satisfied. If not, SKF notifies the customer mentioning the requested delivery date cannot be satisfied and hence we will promise another delivery date.

- Reliability failure is a KPI that measures the broken promises made by the organization. From the example of availability failure, once a new date is assigned by SKF i.e. the new promised date; the organization changes the promised date to another date.
- The KPI of rebooking, postponement and cancellation measures the number of times an order line has been rebooked by SKF. This KPI basically looks at the number of times an order has been either preponed or postponed to the external customers order lines. For e.g. if a factory has reduced its production capacity due to various issues there would be an extensive amount of rebooking's done by SKF relating to "change in promises" to external customers.
- Forecast accuracy is defined as the difference between the actual demand and the forecasted demand. With this KPI in place SKF can determine how well the organization is predicting its upcoming demand. The KPI of bad stock refers to the stock the has stopped moving and is just present at the warehouse. This reflects very low inventory turnover and buildup of unnecessary capital.
- Orderbook management is a process of efficiently tracking and fulfilling the orders placed by customers. This process keeps a record of customer purchase history, payment method and quantity of each order. The KPIs that are measured in SKF under orderbook management is backlog, postponements, cancellations and change in sales order which pertains to either quantity change in their order line or the delivery date.

As aforementioned in the dimension of meetings and collaboration the monitoring of KPIs is very important as these acts as a primary topic of discussion and input for the S&OE process. The KPIs are monitored daily and the overview of the failures or issues that have occurred for the KPIs are discussed in the S&OE meetings. The reasons for the failure and the outputs such as decisions and actions required to manage the KPIs are also discussed in the meetings. For e.g., if there was an availability failure for an item the Operational demand manager determines during the week on why this KPIs has been affected. These issues are then raised in S&OE meetings to communicate with operations in order to determine root cause analysis and possibly obtain a review from other supervisors of the department that also affects the KPIs. Hence, in this scenario of availability failure the discussion would determine why this KPI has failed i.e. was the order an abnormal demand and was there sufficient stock to support in delivering to that particular demand. Therefore, the output would lead to a decision along with relevant stakeholders such as global planners, CSR and factory or logistics to take the necessary actions such as changing forecast and prioritizing the demand.

The weekly review of KPIs is one of the main tasks in the S&OE meetings and it is observed that although the KPIs used in this process is similar to the KPIs suggested by Lindsey (2019), Holmes (2015) and Carvalho (2018), the process is still ineffective in terms of reducing the tied-up capital. Only the KPI of availability failure and reliability failure is given the highest priority followed by order book management. This is because the S&OE team at SKF is only looking at proactively managing the abnormal demand for supply i.e. making sure that customer orders are fulfilled on time to satisfy the SLA (service level agreements) with customers. The fulfillment of customer orders impacts these three KPIs in a positive manner, however, the S&OE team ignores the KPIs of forecast accuracy and stock level which has negatively impacted the inventory levels. The KPI of bad stock + stock level and forecast accuracy is rarely monitored and discussed on the root cause which indicates that the effectiveness of the process is not measured. It is observed that under the KPI of bad stock the "free available non planned stock on hand" which is used to supply for make to order (MTO) environment has the highest inventory level resulting in a high inventory value. According to Smaros et al. (2003) in an MTO the inventory level should be relatively low; as this production method only produces when an order is placed.

4.6.4 Information technology

When considering the stance of SKF's information flow, SKF uses digital twin technology to exploit data from business intelligence servers where all the information from different data warehouses are gathered, such as from sales data warehouses consisting of sales related information and several other data warehouses from the supply side which may consist of inventory related information. This data from the business intelligence server is converted to an interactive visualization with a simple interface for the stakeholders by using the business analytics service by Microsoft. Hence, both the demand and supply related information is gathered in a business intelligence server which clearly explains the use of centralized information at SKF. Now for the S&OE process, these dashboards are used by the stakeholders to observe and analyze the demand and supply inputs that affect the S&OE process and based on which the decision or outputs are concluded. Hence, it can be said that SKF is itself in a good stance in terms of IT tools and Analytics.

Another important aspect of the S&OE process is to establish good communication between stakeholders at an operational level such as customer service representative, supply planners. Hence, with regards to the information sharing mechanism, there exists a global online workflow tool where a communication can be established globally between demand and supply side. One example could be how these workflows are used is to gather market intelligence. Suppose if there is an event of abnormal high demand from a customer, global planner raises an inquiry in these

online workflows to the customer service representative who indeed liaises with the customer to gather more information whether this customer will order in the subsequent months or not.

4.6.5 Integration between sales and operations

This dimension of the maturity model discusses how well the S&OE plan is integrated in the SKF E2E supply chain. In SKF the S&OE process is currently asymmetrical, i.e. the demand forecast that the statistical tool (SO99) generates operations needed to supply it. The main goal of S&OE at SKF is only to handle large deviations and match supply and demand. Thus, there is no clear goal of profit optimization on the longer horizon, SKF, does not try to improvise the S&OE process accordingly to what the process is capable of i.e. more efficient inventory deployment which focuses on reducing stock outs, increasing average customer level, reducing expedites and reduce inventory waste. It is observed that the operations side of the supply chain does not take any part in S&OE meetings. This is because the S&OE process which is conducted under demand management is focused on only attending to abnormal demand i.e. trying to clean the sales order flowing in so that the operation team can comply and supply it. Therefore, involvement of supervisors from logistics, procurement, production does not exist. Another reason for the lack of involvement of from operations side is due to the reason that there is too much complexity in the organization structure, for e.g. SKF has around approximately 30 factories producing various product groups; hence, it is difficult to include the production team into S&OE meetings as information and availability of supervisors could get complicated.

4.7 Demand planning maturity

According to Holmes (2015) and Lindsey (2019), the demand plan is an essential input for the demand control or S&OE process. Hence, the readiness of demand plan as an input for S&OE process is dependent on the maturity of the process of demand planning Vereecke et al. (2018). This is because if the demand planning maturity is increased, the demand plan will also have an increased accuracy. Also, as SKF's S&OP process is in an implementation phase, it could be of value to determine the readiness of demand plan for the first stage of S&OP process. Hence, the integrated planning as well as manager of global planning and demand management was sent a survey to determine the maturity of the demand planning process. Figure 24 shown displays the results of the survey conducted.

Firstly, SKF is in a stage of low maturity where they have a detailed tailoring forecasting technique for products with different characteristics. This could be due to the fact that the industrial market is serving large customer groups with their wide range of product portfolios.

Hence, identification of the demand stream entailing each product characteristics is a cumbersome task. Secondly, SKF industrial markets is in the initial stage of implementation of vendor managed inventory which aims to have direct links with its customers for acquiring point of sales data, hence there is low maturity in terms of customer integration. Thirdly, considering the data management, there is less defined forecast policy in place for the date which is used in the system which SKF adheres to. Lastly, it also could be highlighted that there is less stress on the usage of forecast accuracy even though it is considered to be one of the KPIs to determine effectiveness of the S&OE process at SKF. Hence, in terms of performance management, there is no adjustment done to forecast accuracy from the industry benchmarks. In addition to that, the level of sophistication to determine forecast accuracy is low, for instance there are no different forecasting accuracy targets which are set based on a combination of historical performance and specific market conditions.

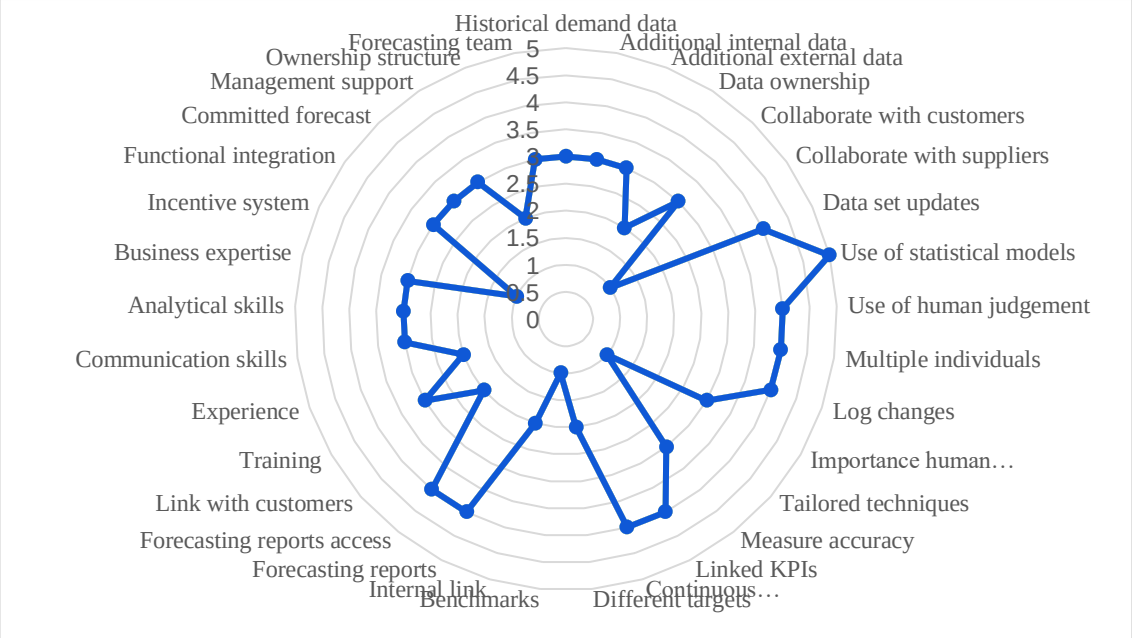


Figure 24: *Results of the demand planning assessment done. Source: Results from survey done at SKF by Authors*

5 Analysis and discussion

The theoretical framework is used to make an analysis of SKF's current S&OE process, which in this case specifically means a comparison between the described theoretical S&OE characteristics and descriptions of SKF's process. Then, roles and responsibilities of the S&OE team and stakeholders involved are assessed using the RACI matrix with a focus on roles and responsibilities of Operational demand manager. Followed by an S&OE maturity model adapted from Grimson & Pyke (2007). This framework is used to analyze and discuss the S&OE maturity. The relevant gaps that are identified are then subsequently systematically prioritized according to how viable filling of a certain gap would be and what outcome it would entail, as for enabling the creation of a structured plan for action.

5.2 Comparison of characteristics with SKF's current S&OE process

In this section, the characteristics of SKF's current S&OE process is analyzed and discussed with existing S&OE model in literature i.e. the proposed S&OE model by Carvalho (2018). The S&OE process is specifically conducted in SKF's industrial market where there is wide range of product portfolios which is distributed among large number of customers whose purchasing contribution is very less to overall demand of the product. For example, for a product in industrial market, a customer contributes 0.1 or 1% to the overall demand of the product. This makes the inflow of abnormal demand from large number of customers a major factor to decrease the forecast accuracy; in turn making it difficult for statistical forecasting when it is aggregated to higher levels. Hence, the goal of S&OE at SKF is to control the inflow of abnormal demand on SKU level because of product complexities.

Process Model

The S&OE process takes place over the horizon of 4 months considering product granularity which is at SKU location level. But there is no product segregation done at SKF, i.e. SKU level for critical products and subfamily level for non-critical products (Carvalho, 2018). In the current context of SKF, as there is a large portfolio of products distributed among a large number of customers, there are difficulties in segregating products with regard to receiving high variations in demand. Since recently, abnormal demand is segregated with the aid of a large order filter in the demand chain control tower which distinguishes an item quantity wise which has received a

large order. With respect to S&OE the time bucket and meeting frequency, the S&OE process is conducted in a similar fashion by SKF as mentioned by Carvalho (2018).

Stakeholders

The stakeholders involved in an S&OE process are Operational demand manager, decision maker from sales, customer service representatives and business controllers from finance. It is observed that the operations side of the supply chain does not take any part in S&OE meetings. This is because the S&OE process which is conducted under demand management is focused on only attending to abnormal demand caused by the demand side. At SKF, the S&OE process is conducted by the Operational demand manager who is the facilitator of S&OE. From the sales side customer service representatives (CSR) also actively participate in the S&OE process and meetings wherein their responsibility is to co-ordinate the information regarding demand and supply to the customers. For e.g., when an abnormal demand such as a high order is placed by a certain customer for a specific item, CSR interacts with customers to determine on why such a demand has been placed. By determining if it is a one-time demand or new increase in demand it helps SKF to prepare stocks accordingly to deliver to that customer. This increases demand input to prevent supply related issues. Operational demand managers play a very crucial role at SKF to keep a track of forecasts on short horizons and indicate when an abnormal demand is noticed on SKU level. The abnormal demand is questioned by Operational demand manager or Global planner to CSR's via Demand management enquiries (DMI's).

Roles and responsibilities

Within the demand management organization there are executives who monitor and facilitate a smooth operational process. For e.g. the organization provides tutorials on new applications required by managers to make certain autonomous decisions. Their presence in S&OE meetings are always important as they try to mature the S&OE process in the long term by observing daily activities performed by active participants. The S&OE meetings conducted at SKF includes a S&OE leader who is a part of the sales organization who in this scenario is the Operational demand manager. In some regions of SKF there are Operational demand managers and Strategic demand managers. The role of the Operational demand managers is explained under the roles and responsibilities section of the S&OP maturity model. It is observed that the operations side of the supply chain does not take any part in S&OE meetings. This is because the S&OE process which is conducted under demand management is focused on only attending to abnormal demand and since SKF has factories in many locations, it is practically difficult to involve the supply side for S&OE discussion regarding a particular sales region.

Carvalho (2018) mentions that there should be a separate S&OE organization with a group of analysts responsible for analyzing data to elaborate on reports, monitor KPIs and reports, daily follow up on deviations and always looking for opportunities. The final decisions in S&OE meetings are made by the S&OE leader from the sales organization, the S&OE leader has authorization to make final decisions that reflect changes made to facilitate the handling of abnormal demand. Currently at SKF, there is S&OE team under demand management i.e. there are employees who give equal attention to S&OE process while also performing other daily tasks as mentioned in the roles and responsibilities section under chapter four.

Tools and technologies

SKF currently uses an in-house ERP system to support its decision-making for the S&OE process. Primarily business intelligent servers are used for the S&OE process for monitoring demand on item level. Information is gathered from various departments and presented in S&OE meetings in presentation formats where an S&OE champion leads the meetings. Participants perform an advanced analysis with use of control tower dashboards for tracking KPIs that provides necessary aid for Operational demand managers in performing their daily tasks which act as an input to the S&OE meeting.

Key performance indicators

As aforementioned in literature review; KPIs are used to measure the effectiveness of the business process used in the organization. The KPIs used at SKF are described in detail in chapter four under the section measurements.

Overall, the S&OE process at SKF has characteristics that are similar when compared to the theoretical model proposed by (Carvalho, 2018). Although some domains are related to making S&OP process easier by unfolding tactical plans, and since, SKF currently does not have S&OP process these domains can be negligible as the objective of the process would vary depending on the context of the situation. For e.g. the strategic alignment described by Carvalho (2018) would be to connect tactical plans to operational plans by unfolding tactical plans into less aggregated information. But, the strategic alignment at SKF would be to only handle deviation for the short horizon due to the lack of tactical plans. The Table 7 below presents an analysis of the S&OE process of SKF using Carvalho (2018) proposed S&OE model.

Domains	**Main aspects**	**Carvalho (2018)**	**SKF**
Process model	Horizon	3 months	1-4 months
	Bucket	Weekly	Weekly
	Product segregation level	SKU level for critical products, subfamily for non-critical products.	No product segregation done as critical and non-critical products

	Meeting frequency	Once a week	Once a week
Stakeholders	Meeting owner	S&OE leader	Operational demand manager
	Meeting participants	Managers from the areas: 1. Production 2. Inventory 3. Sales 4. Supply chain 5. Purchasing 6. Finance 7. IT	Managers from the areas: 1. Operational demand manager 2. Sales 3. Customer service representative 4. Finance
	S&OE leader	"An unbiased person responsible for coordination of S&OE activities with aligner role. Owner of S&OE meeting and a participant in S&OP meeting" (Carvalho, 2018, p.99)	Operational demand manager is the owner of the S&OE process and is a part of sales organization.
Roles and responsibilities	S&OE team	"There is a dedicated S&OE organization with a team of demand analysts "responsible for running the systems to generate programs, analyze information to elaborate reports, monitor KPIs, daily follow up on deviations and looking for opportunities". The S&OE team should have autonomy for making small and routine decisions related to S&OE"(Carvalho, 2018, p.99).	S&OE team under demand management with a dedicated Operational demand manager who is responsible for S&OE process. The decision maker is from sales organization.
Decision making	Scope and triggers	"Balancing of orderbook, Disaggregate S&OP plans, ensure fulfillment while maintaining customer service level" "(Carvalho, 2018, p.99).	The S&OE process has been set up with the focus on the customer and demand side of the full E2E Supply Chain, including short term planning, demand monitoring and abnormal demand handling in combination with strategic planning.
	Autonomy	"Routine decisions that are provided in daily operations, provided they have knowledge and autonomy to do so. Decisions that affect longer periods and that can have impact on several	The operational demand manager is responsible only for S&OE process, but the decisions are limited. There is also a decision maker from sales

		functional areas should be made by the forum present in the S&OE meeting"(Carvalho, 2018, p.99).	organization who has full knowledge of demand side issues and has the authority to make final decisions in S&OE meetings.
Functional areas	Owners	Depends on organizational structure	Part of demand management under sales organization.
Tools and technologies	Supporting technologies	ERP – MPS & MRP. For a higher degree of maturity, APS can be used.	In house ERP (DOH, COH), Dashboards, Digital Twin, Communication tool.
	S&OE cockpit	Excel or Access tools	Dashboards
Key performance indicators	KPIs	1. OTIF (On time in full) 2. Adherence to the programs 3. Inventory health (stock out, excess stock, reproved stock, etcetera. 4. Service level 5. Backlog 6. Change in sales order 7. Effectiveness	1. Stock level + Bad stock 2. Availability/ Reliability/ Rebooking 3. Forecast accuracy 4. Order book management a. Order book on hold for next 3 months. b. Overdue shipments c. Postponements and cancellations
Relevance	Strategic alignment	"S&OE is an enabling process which also considers strategic plan to make sure the important drivers of strategic business plan are agreed and followed up during operational execution activities" "(Carvalho, 2018, p.100).	The goal is to have a control over the demand side issues and handle deviations that arise in the short horizon.
	Value creation	"The S&OE process creates value by bridging S&OP tactical plans to operational execution. This is done by reacting to short-term changes in demand forecast, sales orders received from customers and minimizing cost related to lack of efficiency of production and sales orders" "(Carvalho, 2018, p.100).	SKF due to various complexities are unable to set up S&OP process due to which S&OE is setup to have control over the demand side issues. This is done by reacting to demand abnormalities in shorter horizon resulting in minimized inventory.
	Goals	"The goal is to connect tactical planning to operational execution and unfold tactical plans into less aggregated information with high granularity of	The company's goals are to better track the abnormal demand and maintain high variations by having control in a shorter horizon.

		data" "(Carvalho, 2018, p.100)	

***Table 7**: Comparison of characteristics of Carvalho (2018) versus SKFs process. Source: Author's Contribution.*

5.3 Roles and responsibilities matrix

Based on the workflow of S&OE process, from the observation in S&OE meetings, interview with subject matter experts and understanding the current roles and responsibilities of Operational demand manager, a responsibility matrix was developed which is self-explained in Table 8. This Table 8 consists of main activities i.e. deviation handling and abnormal demand management, documentation of S&OE process deviations and making actionable plans/ decisions. Also, "R" indicates Responsible, "A" indicates accountability, "C" indicates consulted and "I" indicates informed.

Deliverable / Activity		**Op. demand manager**	**CSR (Sales)**	**Decision maker from sales**	**Supply planner/ Global Planner**	**Subject matter experts**
1	Evaluate deviations and opportunities from demand and supply inputs based on the set KPIs to provide insights on abnormal demand.					
1(a)	Evaluate deviations and opportunities from demand and supply inputs.	**R**			**R/A**	
1(b)	Raise a demand management enquiry (DMI) against abnormal demand to customer service representative.	**R**	**A**		**R**	
1(c)	Evaluate KPIs such as reliability, availability, bad stock, etcetera.	**R**	**R**	**A**	**R**	
1(d)	Review the abnormal demand and send the enquiries to customer service representative (CSR).	**R**	**C**		**R/A**	
1(e)	Gather quality market intelligence to respond to DMIs		**R/A**		**I**	
1(f)	Manage abnormal demand and plan change requests.	**R**	**C**		**R/A**	
2	Prepare agenda for S&OE meeting and demand control report consisting of documentation of deviations	**R**	**C**	**C**	**C**	**I**

3	Make an actionable plans/ decision related to S&OE	**R**		**A**		

Table 8: *RACI matrix for S&OE process. Source: Author's contribution.*

When compared to the available theory of demand execution manager as mentioned in Lindsey (2019) against the roles and responsibilities of SKF's Operational demand manager gaps were identified. Firstly, it was analyzed that the Operational demand manager does not spend time analyzing the S&OP plan or demand plan against the customer orders received. This is mainly due to the reason that forecasting system can generate forecasts on item location level if high granularity is considered, but there is no forecasting done on customer level. Hence, there is no proactive reconciliation of customer order against the demand plan or S&OP plan received. Secondly, there is no scenario analysis done in cases where demand materializes differently than planned i.e. in case when demand exceeds more than supply as well when supply exceeds more than demand. Thirdly, the demand execution manager can also participate in S&OP meetings of the respective sales region to have a better understanding of the agreed demand plan. Lastly, the demand execution manager should stress on the importance of forecast accuracy and effectiveness of meeting and ensure that effectiveness is improved consistently. Based on these gaps identified, the roles and responsibilities of demand execution manager were compared against the same roles of different companies to arrive at a more practical solution to the case company. This recommendation was checked with Subject matter experts (SME) to get further inputs of SKF's business scenario to refine the recommendations. Hence, the same is reflected in table 8.

5.4 Contingency theory for the design of an S&OE process in SKF

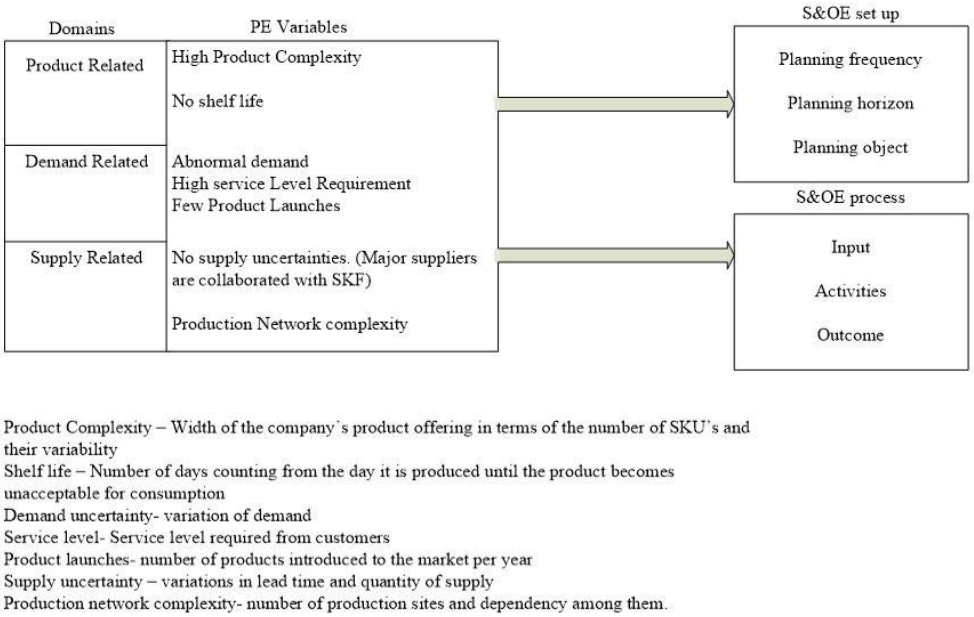


Figure 25: *SKF analytical framework. Source adapted from: Ivert et al. (2015).*

An article by Kristensen & Jonsson (2018, p.20) indicates that organizations plainly following established S&OP frameworks to balance supply and demand do not necessarily obtain the intended result. Hence, "one-size fits all" design description of the S&OP framework is not adaptable for all contexts. As S&OE is a process that bridges tactical planning to operational execution, the same concept would apply wherein a formalized S&OE maturity model to analyze SKF's S&OE process would be irrelevant. Instead, it is ideal to determine the contextual factors affecting SKF and then develop an S&OE maturity model for the organization. Therefore, in order to determine the contextual factors for the S&OE process at SKF, the theoretical framework presented in the literature review chapter by Ivert et al. (2015) is used.

The framework by Ivert et al. (2015) is chosen because it investigates the S&OP process for different CPG industries where the S&OP process is immature, hence, the focus is given to understand the influence of product and market related variables on S&OP design. Therefore, considering SKF context, the organization is also in the similar context where in the duration of this thesis a mini-S&OP process was just initiated. Therefore, we consider adapting the PE variables to the SKF's context as shown in Figure 25. Moreover, the findings by Ivert et al. (2015) contribute to a detailed and dynamic complexity as explained by (Kristensen & Jonsson, 2018).

From Figure 25, it can be observed that the framework is designed considering the S&OE process at SKF. Hence, the set-up parameters and the process parameters would resemble the S&OE

process at SKF while the domains of the PE variables would remain the same as these variables are used in both the S&OP and the S&OE process. The PE variables are segregated based on the relation of product, demand, and supply. Each one of them are explained in detail below with respect to SKF.

The PE variable that is product related is chosen to be high product complexity. There is a high product complexity based on SKF's product offering in the industrial market, as it contributes to many products that are offered to end customers i.e. products such as bearing, lubrications, seals, aftermarket parts of automotive industry and many others. Therefore, due to a wide range of product portfolios of SKF's industrial market there is immense complexity in the product offering at SKF. With regard to the variable of shelf life, it is determined that this variable is irrelevant for the SKF's context as SKF produces non-perishable products. Hence, this variable is not considered when developing the S&OE maturity model for SKF.

The PE variable that is demand related is chosen to be abnormal demand from customers. This is due to the reason that SKF's S&OE process primarily aims at managing abnormal demand placed by customers. In the industrial sector of SKF due to many SKU's, many customers and lack of collaborative planning forecast it is hard to obtain a high forecast accuracy on demand of products or items on SKU level. Hence, currently the demand obtained is only from statistical forecast tool (S099) which forecasts the demand based on the dates of products shipped and quantities that are shipped to the particular customer. When customers place an unexpected order in terms of quantities and delivery date required it affects the statistical forecast in a way that considers that the same customer will place the same order again. But, in reality, the customers would like to have that order delivered only once. Therefore, it requires the Operational demand manager to remove the unexpected order from the statistical forecast and distinguish it from other normal orders. Thus, the demand management organization at SKF is continuously trying to serve the abnormal demand from customers.

With respect to the variable of service level; as SKF is a primary supplier for many industries; it is important that items that are ordered by customers are available in stock and delivered on time to prevent any disruption in the customers supply chain. Despite the abnormal demand, SKF considers all customers as important. With the S&OE process, SKF is trying to serve all the customers to maintain their service levels agreed with their customers. Therefore, SKF has given importance in monitoring their service levels by placing KPIs in S&OE process which reflect on the overall performance and service level. With respect to new product launch, it is observed that SKF's new products that are launched are primarily related to technological advancements. This occurs only when a specific customer orders a product based on certain specifications. But,

majority of the products that customers use is based on already existing products that SKF produces regularly. Therefore, this variable is chosen to be a few product launches per year.

In the S&OE meetings conducted on a weekly basis it is observed that variables relating to supply are hardly discussed. This is due to the reason that major suppliers are collaborated with SKF which rules out most of the supply uncertainties i.e. variations in lead time, quality, and quantity of supply. But, with respect to production network complexity it is observed that a few of SKF's products at a few production sites undergo the process of kitting, hence, there can be issues related to production capacity which can affect delivering customers on the right time. But the variable of production complexity is not taken as an important factor as problems related to production complexity are not discussed at SKU level, but, rather on an aggregated product level. Another factor to consider is, as mentioned before, the S&OE process at SKF is primarily about managing abnormal demand according to supply. At present, SKF has make to stock environment, make to order environment and less of engineer to order environment. Hence, based on the production environment and on the observance of inventory levels, it is considered that SKF has sufficient stock but, it is the priority and handling of orders placed by customers that serve the purpose of S&OE at SKF. Hence, for the development of the S&OE maturity model supply side of the S&OE process is not considered. The PE variable for supply is no supply uncertainties.

The setup parameters as mentioned in the theoretical framework consists of planning objects, planning horizon and planning frequency. With regards to the planning objects, the S&OE process at SKF deals with items on SKU level as mentioned theoretically by Carvalho (2018) and Chainalytics (2019). Due to the immense product complexity in the industrial market and abnormal demand from customers aggregating the demand and then drilling down to serve the customer is a tedious task and time consuming. Therefore, to directly manage the abnormal demand it is efficient and effective when operational demand managers look at specific items ordered by customers to determine if the order can be delivered or not. The planning horizon at SKF in the S&OE process is three to four months. This plan is done in order to determine on how to serve the customer orders on specific items up to this time period. A longer planning horizon would reflect in an S&OP process which in this case scenario it is not considered.

S&OE in other words is a deviation handling process wherein stakeholders look on how to manage abnormal demand and monitor the major affecting KPIs. Plans that are made for three to four-month horizon are either followed or updated on a weekly basis in terms of weekly meetings. Also, by having weekly meetings it serves the purpose of managing abnormal demand collaboratively among different departments frequently.

The process parameters described by Ivert et al. (2015) are inputs, activities, and outputs. From the S&OE process at SKF it is observed that the input activities are creating short-term plans. Whereas, the activities conducted in the S&OE process are monitoring and managing KPIs, conducting weekly meetings and managing abnormal demand with internal coordination among stakeholders. The outcome of the process is to integrate all cross-functional activities from different departments and obtain balance in demand and supply.

Ivert et al. (2015) contributes to how the PE variable can be linked to S&OP set-up and process parameters. Hence, considering the S&OE context of SKF a description is given below on how the PE variables are linked to S&OE set-up and process parameters.

The PE variable of high product complexity at SKF due to a large product portfolio and abnormal demand can be directly linked to the S&OE set-up and process parameters. As mentioned before, there is a wide range of products offered in the industrial market at SKF, hence, the abnormal demand from customers cannot be aggregated into product families as it would require the need to drill down again to determine which item has a specific demand. Hence, by looking at demand on an SKU level, which is the focus of the S&OE process, planning objects of the S&OE set-up parameter can be linked to PE variables of product complexity and abnormal demand. The same PE environments are also considered as an input to the S&OE process parameters which also satisfies the conclusion made by (Carvalho, 2018).

At SKF the goal of the S&OE process is to manage abnormal demand on the short-term. When demand materializes differently than planned the organization is prone to conduct weekly meetings where plans can be changed or updated in order to deliver the demand. Hence, the PE variable of abnormal demand is linked to the planning frequency of S&OE set-up parameters. Maintaining a high service level with customers is a priority for SKF despite having abnormal demands. By conducting weekly meetings with a focus on delivering to each demand increases the service level of customers. Hence, the PE variable of service level requirement is also linked to the activities and outcome of the S&OE process parameter. With respect to PE variable of few product launches, this variable is not given much importance because only very few new products are launched in the market depending on technological advancements. But this PE variable is considered when developing the S&OE maturity model for SKF.

As mentioned before, shelf life is not considered due to SKF producing products that are non-perishable and hence, this PE variable is also not considered when developing the S&OE maturity model. PE variables related to supply are not given much importance when analyzing on linking the supply related variable to S&OE set-up and S&OE process parameters because the S&OE process at SKF focuses only on product related and demand related variables i.e. the process is

more essential to satisfy only the demand side of S&OE process. But, when developing the maturity model, the last stage of the model is considered to balance both supply and demand on a short-term basis. This is because developing the maturity model only for the demand side of the S&OE process would contradict the S&OP and S&OE literature established in this paper. Figure 26 presents the linkages between the PE variables and the S&OE set-up and process parameters. The black arrows represent the link between product complexity and S&OE set-up and process parameters. Red arrows represent the link between abnormal demand and S&OE set-up and process parameters, and the blue arrows represent the link between service level requirement and S&OE set-up and process parameters.

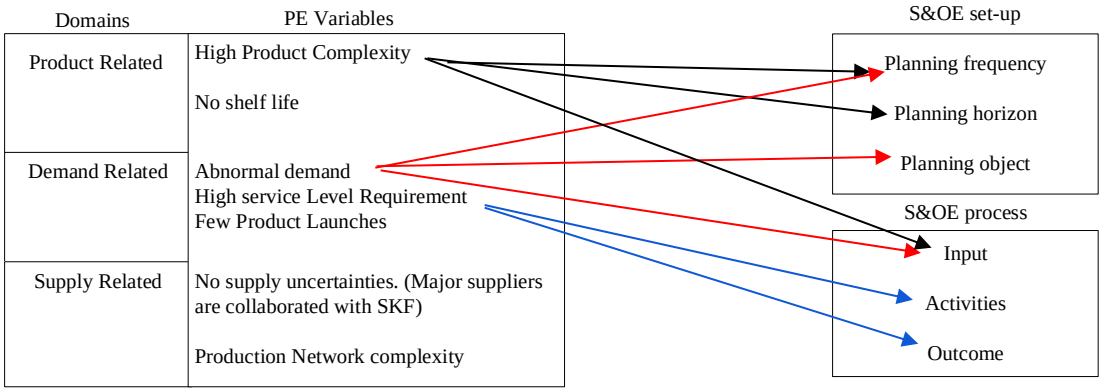


Figure 26: *Linking PE variables with S&OE set-up and Process parameter. Source: Author's contribution*

5.5 Sales and operations execution maturity model

By adapting the dimensions used in Grimson and Pyke (2007) S&OP maturity model to the literature of S&OE process it is possible to develop an S&OE maturity model which can be used to evaluate the S&OE maturity of SKF. This section will discuss on how the S&OP maturity model is adapted as an S&OE model followed by an explanation of S&OE process maturity. Next, this model is used to assess SKF's S&OE maturity which will be determined accordingly.

As mentioned in the methodology section under research question three, Grimson and Pyke (2007) S&OP maturity model is used due to the extensive use of the model, hence, resulting in many citations of their paper over the years. It is observed that there are similar principles between S&OP and S&OE. This was concluded by analyzing the S&OE meetings that have taken place at SKF. Based on the similarities of dimension between S&OP and S&OE process, a conceptual maturity model is developed. The Table 9 shows the adaptation of Grimson & Pyke (2007) S&OP maturity model to the S&OE. At the end of each dimension a table is presented which represents

the overall SKF S&OE maturity level for that particular dimension. The table is color coded, wherein, the green indicates the stages that SKF has obtained and is currently in. Red indicates the stages wherein there is an opportunity to improvise and advance, grey indicates only a partial fulfillment of the stage and blank square indicates non-existence of characteristics within S&OE maturity model at SKF.

Dimension	**No S&OE process**	**S&OE reactive**	**S&OE standard**	**S&OE advanced**	**S&OE proactive**
Meetings and collaboration	No formal meetings. Silo behavior which contributes to individual promises separately by demand and supply (No coordination).	Formal meetings. Discussed in S&OP meetings. Emphasizing on aligning tactical plans to operational execution.	Sales manager/ demand manager are included in the meetings. Formalized meetings. Customer segmentation is done. Narrow focus towards customers as short-term changes may not have a major impact on the suppliers.	Customer data is incorporated. Partnership with strategic external customers when demand materializes differently than planned which benefits the customer.	Event driven meetings supersede scheduled meetings. Real-time access to external data. 100 % reliability.
Organization	No S&OE function	No formal S&OE function. The demand control and execution are acknowledged by demand and supply organization. The demand planning team is transferred the knowledge of demand controlling and execution.	S&OE function is part of another position, responsibility of S&OE function is embedded in other roles. E.g. could be a part of demand manager roles and responsibility to undertake S&OE process.	Formal S&OE team. S&OE demand team. There exists Demand execution manager who is facilitator of S&OE process. Executive level participation	Throughout the organizations S&OE is understood as a tool for deviation that arises from both supply and demand side.
Performance Indicators	No measurements	Measures how well the operations meet sales to the short-term changes in demand variabilities. Example could be a number of abnormal demands flowing in.	Stage 2 plus: Common KPIs among departments at the operational level.	Stage 3 plus: Sales measured on forecast accuracy. New product introduction. S&OE effectiveness and order fulfilment	Stage 4 plus: synchronized demand and supply plans. Company profitability, optimized costs and delivery performance throughout the value chain.

Information Technology - focus on information process rather than business process	Local and isolated systems. No formal use of ERP system for integrated data, Relying more on Spreadsheets for combined tasks	ERP System is used to consolidate data, Manual detection of abnormal demand with less frequent communication between demand and supply.	Centralized information in an automated way. S&OE workbench. Manual detection of abnormal demand with frequent communication between demand and supply.	Stage 3 plus: Automated abnormal detection based on rules.	Stage 4 plus: Integrated S&OE optimization software. Use of advanced analytics. Use of demand sensing technology.
Integration between sales and operations at operational level	No link between demand and supply at operational level, short term changes of customer orders leading to high inventories, expediting activities	Demand plan drives operations with no consideration to capacity utilization	There is integration between sales and operations wherein demand plans are adjusted based on supply.	Demand team is integrated with the supply team wherein both aspects of demand materializing are considered for synchronizing supply and demand.	Seamless integration of short-term changes of both demand and supply side plans. Process aims at balancing demand and supply which leads to an increase in service level.

Table 9: *S&OE maturity framework. Source: Author's own contribution*

5.5.1 Meetings and collaboration

The first dimension of the S&OP maturity model is the meetings and collaboration; this dimension considers the human activity and intelligence required to conduct S&OP meetings. The primary reason why this dimension is considered to be the first dimension of the S&OE process is because the S&OP process consists of cross-functional integration of departments to conduct meetings once a month whereas the similar meetings in the S&OE process are conducted on a weekly basis. The process of S&OE requires an S&OE team consisting of participants from both the demand side including marketing and sales and supply side as described by Grimson and Pyke (2007) for an S&OP team. Hence, the purpose of this dimension in this model is to create a discussion among supply chain partners to execute operational activities by having a mutual agreement on final decisions in the short term to synchronize demand and supply. Also, according to Bagni & Marçola (2019) it can be argued that this dimension not only considers the level of interaction required between different departments within the supply chain but it also reflects on the involvement of management on hierarchical level required to conduct these meetings and the authority given to employees on decision-making with respect to solving problems that occur within these processes.

Recognizing that the frequency of meetings increases in S&OE the characteristics of each stage in the maturity model will change reflecting on an operational level than on a tactical level as

described in the S&OP maturity by Grimson and Pyke (2007). Each maturity stage is explained below.

In the first stage of this dimension there are no formal meetings and collaboration among departments. Employees are more likely to have a mentality of not sharing information between departments within the same company which would result in uncoordinated promises to customers. In other words, promises are made to the customer from one area of the business without acknowledging the area of the business that is responsible for satisfying or delivering the order to that customer (Gattorna and Walter, 1996).

In stage two, senior management is generally involved from both functional areas in creating mutual understanding and collaboration among departments. However, the discussion in these meetings is mainly about aligning tactical plans made in S&OP to operational execution for S&OE process.

In stage three, there is seamless collaboration among functional areas of the supply chain. Plans are shared from both demand and supply sides in the meeting. From the demand side, Sales and Demand managers are involved in the meetings to increase the reliability of demand. Whereas supply chain managers would gather input from sales and aim to minimize any potential fallouts. Primarily in this stage, the meeting discussion consists of customer segmentation to prioritize the customers based on service levels and proactively manage supply and demand for the essential customers, hence, providing a narrow focus to particular customers on the short term (Inc. Oliver Wight International, 2017).

In stage four of this dimension, the organization creates a partnership with strategic customers for scenarios of demand materializing differently than planned. Here the customer demand data is incorporated to some extent. According to Chase & Chase (2016), the scope of partnerships with strategic customers guarantees that customers' needs are understood and "embraced". This enables the organization to handle demand signals in a controlled manner preventing disruptions in the organizations supply chain leading to an optimized supply chain.

In stage five, the organizations apply all characteristics of stage 4 but with an inclusion of event-driven meetings, for e.g. only if it is necessary to conduct meetings when a sophisticated problem arises. This stage is the most proactive stage where all internal and external data of customers and the organization is integrated in real time. According to Grimson and Pyke (2007) the benefits for the organization to advance to this stage would aid sales and operation managers to obtain early warnings of disruption in the supply chain which enables them to take the corresponding actions quickly.

When analyzing the meeting significance, formality, schedule, and the supervisors involved for the S&OE process; SKF can be placed in the third stage of the S&OE maturity model. The inclusion of the Operational demand manager and the sales manager in the S&OE meetings adds value to the S&OE process in terms of normalizing the abnormal demand for the forecasting tool. With regards to customer segmentation, the global planning and demand management organization is currently implementing in segregating customers based on service level which will help in prioritizing the customers that serve the principle of 80-20 rule. SKF can also be placed in stage 4 of this dimension as strategic external customer data is incorporated into SKF's demand system, hence, this helps SKF provide a high service level as agreed with the customer even though demand could materialize differently than planned from the customer. In terms of stage 5 the only improvement is from a regular planned meeting to event-driven meeting. Therefore, it is important that ICT-structure should be present or an S&OE workbench to initiate meetings when an abnormal demand flows in. Although SKF has an S&OE workbench it lacks the integration and the sophistication required to initiate event driven meetings when an abnormal demand is detected.

Stage		S&OE maturity model
1		No formal meetings, silo behavior
2		Basic meetings conducted with Discussion on emphasizing on aligning tactical plans to operational execution
3		Sales manager/Demand managers are included in the S&OE meeting.
		Customer segmentation is done
4		Customer Data is incorporated.
		Partnership with strategic external customers when demand materializes differently than planned.
5		Event driven meetings supersedes scheduled meetings
		Real time access to customer data

Table 10: *S&OE meetings and collaboration. Source: Author's contribution.*

5.5.2 Organization.

According to Grimson & Pyke (2007), this dimension addresses the organizational structure of sales and operations within the company. Both the processes S&OP and S&OE possess similar characteristics having a mutual goal of balancing supply and demand and profit optimization on the longer horizon. Hence, this dimension is considered to be the second dimension of the S&OE model. But the difference is that the synchronization of demand and supply are targeted over a longer horizon for the S&OP process and the synchronization of demand and supply is targeted over a shorter horizon for the S&OE process. Recognizing that both the S&OP and S&OE are horizontal collaboration process within the organization but at the different levels i.e. S&OP done

at tactical levels and S&OE which bridges tactical level to operational level. Hence, the characteristics of each level in the maturity model will change which is as explained maturity stages below:

In the first stage of this maturity model, there is no S& OE function as the S&OE process / demand control and execution is not acknowledged by the organization. There is no knowledge about the S&OE process and the benefits of S&OE that could be delivered to the organization. This is similar to the first stage in S&OP maturity model where there is no S&OP function and is not even part of another function (Grimson & Pyke, 2007).

The second stage of S&OE defined as S&OE reactive is where the S&OE process is acknowledged in organization. Here the tasks of S&OE process are fulfilled by others and again there is no formal function dedicated to the S&OE process. In stage two the S&OE is a process that can help in operational activities by managing demand. It is only discussed within the organization on an executive level but there is no formal implementation procedure, the roles and responsibility of participants are not set, the executive support is still low and the process itself is still yet to be thought through for the benefit of the company. This is like the stage 2 organization dimension of Grimson & Pyke (2007), where there is no formal function and the tasks are fulfilled by others in the organization.

In the third stage of S&OE maturity model, S&OE function is a part of other position i.e. roles and responsibilities of S&OE processes is embedded in roles of other position. For instance, the Demand manager would work both on demand planning and S&OE process. This is as mentioned in the roles and responsibilities of Demand manager from Palmatier & Crum (2003). According to Palmatier & Crum (2003) where one among the duties and responsibilities is to manage change and balance in supply and demand in order to achieve optimal balance between the stability of supply and customer responsiveness.

The fourth stage known as S&OE advanced is where the S&OE process is recognized in the organization. For instance, there is a dedicated position called demand execution or demand fulfillment specialist or demand controller who is the facilitator of S&OE process and S&OE is a formalized part of his/her job. This is as explained in the webinars by Lindsey (2019) and Holmes (2015), where there is mention of the role of dedicated individual for fulfilling the roles and responsibilities of the S&OE process. Another characteristic of this stage is the S&OE team that has executive level participation for supporting the S&OE team in decision-making or giving out suggestions to action plans.

In stage 5, S&OE process has a formal S&OE team with executive level participation and is well-recognized and respected throughout the organization as a tool for handling variabilities from

both supply and demand side. The discussions and negotiations between different stakeholders in S&OE meetings contribute to profitability of the company. It is similar to stage 5 in the Grimson & Pyke (2007) where it also relates the S&OP process as the one which is well-recognized throughout the organization and ultimately can contribute to the profitability of the company.

By analyzing the different stages of the S&OE maturity model to SKF's S&OE process, SKF's S&OE process can be clearly placed in fourth stage of the maturity model as the S&OE process is well defined and thought through to aid the company in handling deviations that arises in short term. With respect to S&OE team and stakeholders involved, the roles and responsibilities of facilitator of S&OE process i.e. Operational demand manager is defined and set which is explained in section 4.4. It is also identified that there are fewer clarities as to what the roles and responsibilities of sales/customer service representatives could be which is better identified in the analysis of roles and responsibilities. The S&OE process currently has the decision maker who has more extensive knowledge in working on the demand side who participates in S&OE meetings to aid in decision-making and subject matter experts if there are complexities in decision-making.

Stage	Color	S&OE maturity model
1		No S&OE function
2		No formal S&OE function.
		The demand control and execution are acknowledged by demand and supply organization. The demand planning team is transferred the knowledge of demand controlling and execution.
3		S&OE function is part of another position, responsibility of the S&OE function is embedded in other roles.
4		Formal S&OE team. There exists a demand execution manager who is facilitator of the S&OE process.
		Executive level participation of S&OE process.
5		Throughout the organizations S&OE is understood as a tool for deviation handling.

Table 11: *S&OE organization. Source: Author's contribution.*

5.5.3 Performance Indicators

The key performance indicator is a performance measurement which allows us to gather knowledge and explore the best way to achieve organization goals. Kelber (2020) states that in order to establish KPIs for the S&OE process, an organization must first start assessing KPIs that are used in the S&OP as most likely similar KPIs will exist in both processes. Hence, the stages discussed in the following paragraph will relate to KPIs in the S&OP process.

Stage one of this dimension the organizations use virtually no measurements neither in sales side nor in operations side. In stage two, organizations use measurements to assess how well the

operations meets the sales plan to the short-term changes in demand variabilities. For e.g. using the KPI of the number of abnormal demands flowing in as discussed by Lindsey (2019). In this stage, emphasis is also given to the departments that are accountable to monitor and measure such KPIs i.e. in this scenario sales. According to Grimson and Pyke (2007) operations blindly follow sales orders to produce products with little opportunity to create an impact on change of sales orders based on capacity.

In stage three, the firm measures the performance of operations and there are common KPIs used to measure the performance of each department at operational level such as OTIF (Lindsey, 2019). In stage 4, it includes measuring KPIs of stage 3 and includes measuring the effectiveness of S&OE process and new product introduction. The S&OE effectiveness is measured by using KPIs such as forecast accuracy. Primarily, Senior manager holds the sales department responsible to monitor and increase forecast accuracy which give the production an opportunity to improve their planning efficiency and excellence (Grimson and Pyke, 2007).

Stage five includes measuring the KPIs established in stage 4 and involving aggregated level KPIs to measure how well demand is synchronized with supply; one such KPI could be OTIF. In the final stage S&OE is understood as a process which delivers profitability hence senior management hold both demand and supply sides accountable to monitor KPIs corresponding to inventory management and delivery performance which gives attention to reducing inventories and optimizing production and reducing costs to achieve profitability and balance in demand and supply as stated by Grimson and Pyke (2007).

When analyzing this dimension in terms of SKF it can be said that SKF is currently in stage 3 as sales and demand management organization have the same KPI's to monitor and manage at an operational level. SKF also passes the second stage as it measures on how well the operations side of the supply chain is performing with the KPI's of availability and reliability failure which corresponds to the KPI of OTIF. With respect to stage four, as discussed in section 4.5.3 under this dimension, even though the KPI of forecast accuracy is in place, it is ignored by sales and Operational demand manager. This is because there is a lack of acknowledgement on interdependencies of this KPI i.e. there is a lack of understanding on how forecast accuracy when not measured impacts the inventory, lead times and customer service level as discussed by Jordan & Messner (2020). Moreover, SKF also lacks the understanding of the performance of forecast accuracy based on industry benchmarks. There are also situational factors and conditions which challenge the controllability of forecast measures. For instance, SKF had a large deviation from the planned forecast when there was country wide lockdown in India which indicates that

controllability of forecast accuracy is dependent on uncertainty of demand. With this in mind, a question is raised on whether a strong emphasis on forecast accuracy is desirable within SKF.

Stage	Color	S&OE maturity model
1		No measurements
2		Measures how well the operations meet sales to the short-term changes in demand variabilities.
3		Stage 2 plus: common KPIs among departments at the operational level
4		Stage 3 plus: sales measured on forecast accuracy
		New product introduction
		S&OE effectiveness and order fulfillment
5		Stage 4 plus: synchronized demand supply plans.
		Company Profitability, optimized costs and delivery performance throughout the value chain.

Table 12: *S&OE performance indicators. Source: Author's contribution.*

5.5.4 Information technology

For both the business processes i.e. S&OP and information technology are very essential. This dimension enables to assess the integration of software applications that are present within the firm with a focus more on information process rather than business process (Grimson & Pyke, 2007). By online integration of systems data combined and presented to different stakeholders to make consensus regarding the balance of supply and demand. For both S&OP and S&OE processes, the software systems would remain the same in terms of managing the products on product family level, but the systems for S&OP and S&OE process depend on the goal and value creating proposition. For e.g., a mature S&OP system would be linked to the ERP software and have integration of customer and supplier data. This way visibility of data is created where it is easier to obtain a synchronization in the supply chain. Carvalho (2018) considers the significance of ERP systems for the S&OE process as it helps in monitoring the operations conducted. When considering the maturity for the S&OE model, this would also resemble the same as that of the Grimson & Pyke (2007) S&OP model wherein for the earlier stages there would be no consolidation of data from different stakeholders or suppliers and customers. As stages progress, higher maturity is achieved where customers and supplier data are integrated in software application and analyzed in real time creating visibility throughout the supply chain. Since the characteristics of software applications are similar for both processes i.e. integration of data from different stakeholders this would be feasible to consider this as the fourth dimension of the S&OE model.

In stage 1 of information technology dimension, there is no formal use of ERP system for the combined tasks where the data is secluded only to that specific department. There is resistance

between the departments to share the information for fulfilling the combined tasks as there is very less collaboration between the supply and demand side departments at operational level. This can be correlated to the first stage of Grimson & Pyke (2007), where there is information owned by different departments but it's neither shared nor merged.

In the stage 2, ERP system is used to consolidate data and there is sharing of information. Each team uses spreadsheets and power-points for the combined tasks in the S&OE process to collect and present the data, the spreadsheets and power-points are shared along with other departments through an internal communication platform. This S&OE process itself is like the second stage of Grimson & Pyke (2007) S&OP maturity model where it involves collaborating with different stakeholders for information and is consolidated to analyze demand and supply related information.

The stage 3 defined as S&OE standard addresses a centralized platform of data collection and presentation. Both demand and supply related information is gathered in one business intelligence server and dashboards can be used to portray data which can further be used in S&OE process and decision-making. In addition to that, this centralized information is exploited to detect abnormal demands manually. This can be compared to SKFs stance months ago where all involved stakeholders in S&OE meetings refer to the demand chain control tower, a centralized platform which uses digital twin technology, and the information is displayed in the form interactive dashboards. These dashboards are used by stakeholders to observe and analyze KPIs that affect the S&OE process. For instance, the demand chain control tower is used as a standard platform to monitor demand on SKU level by many stakeholders and to analyze KPIs and perform tasks accordingly are set to measure a certain customer service level for specific products for which inventory levels are continuously monitored. Another aspect which SKF stresses is information sharing mechanism, bringing in more transparency to both demand and supply side. There exists also a global online workflow tool where a communication can be established globally between demand and supply side. These supports in the abnormal demand management where the abnormal high or low demand is captured and is manually corrected against the forecasting system.

The stage 4 of S&OE maturity model is the addition of the stage 3 and automated abnormal demand detection system. The reason for the stress in abnormal detection is due to the fact that, for the current context, abnormal demand forms the major issue while the statistical forecast is operationalized. This can be compared again with SKF stance right now, where they are in the implementation phase of the automated abnormal demand detection system using service now based on abnormal demand rules.

In the stage 5 of S&OE maturity model, is quite advanced wherein firms will retrieve real-time information and uses integrated S&OE optimization software, where the supply and demand side abnormalities is detected and automatically adjusted with industry 4.0 technologies such as machine learning and artificial intelligence. In addition to this, is a capability to oversee demand from a customer as to when, where and how much they would order. This can be done by establishing demand visibility throughout the organization using demand sensing which in turn can facilitate organization to have an agile response done. According to Chase & Chase (2016), demand sensing is the technology which enables to use granular downstream data to reconcile the demand forecasts of the short-term and inventory positioning for a forecast horizon of 0 to 3 months.

SKF's S&OE process in terms of information technology can be placed in stage 4 of the S&OE maturity model as shown in Table 13. In terms of S&OE at SKF, the overall goal of S&OE is to react to changes rapidly by not overtaxing operations in the supply chain i.e. to have agile response to short term changes received from both demand and supply side. Therefore, SKF has a combination of software systems that facilitates a smooth S&OE process which includes centralized information, dashboards and recently developed an automated abnormal demand detection tool to identify the abnormal demand which is explained in detail in stage 3 and stage 4 of the maturity model.

Stage	Color	S&OE maturity model
1		Local and isolated systems.
		No formal use of ERP system for integrated data.
		Relying more on spreadsheets for combined tasks.
2		ERP systems are used to consolidate data.
		Manual Detection of abnormal demand with less frequent communication between demand and supply.
3		Centralized information in an automated way.
		S&OE workbench. Manual detection of abnormal demand with frequent communication between demand supply.
4		Stage 3 plus: Automated abnormal demand detection based on rules.
5		Stage 4 plus: integrated S&OE optimization software.
		Use of advanced analytics. Use of demand sensing technology.

Table 13: *S&OE information technology. Source: Author's contribution*

5.5.5 S&OE Integration

This dimension measures the degree of integration of S&OP process that is incorporated in different departments i.e. "it measures how effectively a company builds its demand plan and

supply plan and how well the plans interface" (Grimson & Pyke, p.335). The S&OP process tries to integrate the plans from supply side and demand side at the tactical level of the planning hierarchy. But S&OE, it tries to integrate S&OP plan to operational execution. Hence, in S&OE context, both the demand and supply plans generated at the operational level should interface to realize profit optimization at the highest maturity stages. When making a comparison, S&OE also should advance the maturity in a similar way with no integration between demand and supply plans in the first stage and as the maturity stage advances the integration between demand and supply plans are improved. The advance maturity stage of S&OE should also aim for a process that aims to balance demand and supply which leads to an increase in service level.

In the first stage of this model, as mentioned earlier there is no link between demand and supply in operational level hence when products are manufactured in MTS or MTO environment short-term change in customer order book i.e. postponement, preponement and cancellations will lead to high inventories and expediting activities.

In stage 2 of this dimension, according to Grimson & Pyke (2007, p.335) the demand plan drives "the operations plan and it's purely a one-way process". Also, the demand plan in this stage is not refined by the inputs from the supply side i.e. there is no consideration to the operations plans which ultimately hinders the organization's supply chain as Grimson and Pyke (2007, p335) describes it "capacity utilization dynamics are ignored".

In stage 3 of this dimension, there is integration between sales and operations wherein demand plans are adjusted in a way that matches supply. This stage of the dimensions is identical to the S&OP maturity model from Grimson and Pyke (2007). Also, Grimson and Pyke (2007) discuss that organizations move forward with bottom-up forecasts which aid in altering operation plans according to business and financial goals. Bottom-up forecasts consider analyzing the factors that relate to production capacity, expense on each supply chain department and "addressable market" to generate a more reliable sales projection. Therefore, an e.g., in this dimension could be sales participation in gathering quality market intelligence to generate a more accurate sales forecast.

In stage 4 of this dimension, the demand execution teams are integrated with operations where both the aspects of demand materializing differently than planned are considered as mentioned in Lindsey (2019) and Holmes (2015). This stage pertains to the process of developing sales and operation plans in a collaborative manner where the planning process of both sides of the supply chain is done simultaneously rather than sales initiating the planning stage in the beginning as discussed by Grimson & Pyke (2007).

In stage 5, there is seamless integration between demand and operations where even the short-term changes in demand and supply plans would not hinder or disrupt the E2E supply chain. The

primary aim of the process in this stage is balancing of demand and supply which leads to an increase customer service level and reduced costs. This is in accordance to Grimson and Pyke (2007) where all the constraints pricing, capacity constraints, inventory etcetera within the supply chain are considered.

In stage 1 of the dimensions there is no formal execution i.e. there is no collaboration among stakeholders on the discussion of capacity to match incoming orders. In this stage operations only attempt to supply for the incoming orders. SKF currently is not in this stage and it is much mature. In stage 2, the sales plan drives the operations. In this stage the S&OE process at SKF currently only uses the forecast from SO99 to drive major operations. i.e. demand forecasts are used from this tool to plan for productions as there is no information from production taken as an input. There is no matching of supply and demand. This fulfills stage 2 for the S&OE process at SKF. Although, executives from sales are involved in S&OE meetings production plans are still decided based on forecasting tools. This means no operational information is used to modify the sales plan referring to the fact that capacity utilization dynamics is ignored. Hence, in this dimension of the S&OP maturity model SKF can only be placed in the stage 2 of this dimension and this provides an opportunity for SKF to improve to the next stages in order to balance demand and supply.

Stage	Color	S&OE maturity model
1		No link between demand and supply at operational level.
		Short term changes of customer orders leading to high inventories, expediting activities.
2		Demand plan drives operations with no consideration to capacity utilization.
3		There is integration between sales and operations wherein demand plans are adjusted based on supply.
4		Demand team is integrated with the supply team wherein both aspects of demand materializing are considered for synchronizing supply and demand.
5		Seamless integration of short-term changes of both demand and supply side plans.
		Process aims at balancing demand and supply which leads to an increase in service level.

Table 14: *S&OE integration. Source: Author's contribution*

6 Recommendations

By understanding the gaps from the analysis and fulfilling the aim of improving the S&OE process at SKF, the recommendations are developed which is summarized as below.

6.2 Short term

In this section the description regarding the recommendations which can be fulfilled in the short term are explained. This section consists of two recommendations which includes a proposal for roles and responsibilities of Operational demand manager and a proposal for stressing on the importance of forecast accuracy and improving demand planning maturity.

6.2.1 Roles and responsibilities of Operational demand manager

One of the major areas to improvise in the S&OE process at SKF was to determine the clear roles and responsibilities of the Operational demand manager performing the S&OE process. In order to clearly define and set the roles and responsibilities, SKF's roles and responsibilities of Operational demand manager were compared with the roles and responsibilities of demand execution manager explained by Lindsey (2019) and Holmes (2015). Moreover, to increase the validity of this section the roles and responsibilities proposed by us, an extensive exploration among other companies with similar context was conducted to arrive at the final recommendations for this section as shown in Figure 27.

S&OE/ Demand control 85% of total FTE	Related to demand management 10% of total FTE
1. Abnormal demand management a) Analyze the KPIs on daily/weekly basis and identify and evaluate key deviations and opportunities to provide insights on abnormal demand to key stakeholders. b) Facilitation of decision making when demand materializes differently than planned and participate in the development and evaluation of what-if simulations to resolve demand/supply imbalances. c) Works in conjunction with Customer Service, Demand Planning, Supply Planning, Sales & Marketing Teams to support and manage abnormal demand and plan change requests. **2. Communication & collaboration** a) Tracking on pendency of DMI responses from supply planners and CSR; and ensuring the response time for feedback is minimum. Escalation to concerned department if DMI response time has increased. b) Collaborate with marketing, sales and customer service representative to gather quality market intelligence with regards to S&OE context. **3. Effectiveness** a) Publish forecast accuracy, including forecast error (MAPE and bias performance or forecast value added). **4. Continuous improvement** a) Continuous Performance optimization- in-depth collaboration with the all stakeholders of the different regions in order to optimize the performance targets.	1. Manage relationships with the business and sales/marketing and inform global planning and demand management team of the Supply chain agreements, NAR and contract stock for the key customers. 2. Participate in meetings for demand categorization and provide inputs and support in providing different demand streams, business trends, market specific knowledge gathered working with Sales team, Product managers, Customers and Supply Chain teams. 3. Highlight the network and order routing issues in the S&OE meeting and liaise with global planning and demand management team if any issues related to network management. **Related to demand planning and forecasting 5% of total FTE** 1. Develop a good understanding of demand related issues and have an overall knowledge of forecasting procedure and methodologies.

Figure 27: *Roles and responsibilities of Operational demand manager. Source: Author's contribution*

The roles and responsibilities were decided to be split into three categories, namely, related to S&OE, related to Global planning and demand management and related to demand planning and forecasting. First category, namely, “related to S&OE” depicts the roles and responsibilities that needs to be undertaken to perform S&OE. Second category namely “related to Global planning and demand management” the roles and responsibilities that need to be undertaken related to global planning and demand management at SKF. Third category, namely, “related to demand planning and forecasting” signifies the importance of having knowledge of related to demand planning and forecasting.

With respect to roles and responsibilities related to S&OE, the demand manager needs to dedicate 80 % of his time to on abnormal demand management which includes the following:

- Analyze the already set KPIs on a daily/weekly basis on which he/she needs to identify and evaluate key deviations and opportunities to provide insights on abnormal demand to key stakeholders.
- Facilitate decision-making when demand materializes differently than planned and participate in the development and evaluation of what-if simulations to resolve demand/supply imbalances.
- Operational demand manager should work in conjunction with customer Service, demand planning, supply planning, sales & marketing teams to support and manage abnormal demand and plan change requests.
- The Operational demand manager should focus on developing communication & collaboration among the stakeholders participating in the S&OE process which includes tracking on pendency of DMI responses from supply planners and CSR; and ensuring the response time for feedback is minimum. Escalation to concerned department if DMI response time has increased. Also, Operational demand manager should be a collaborator with marketing, sales, and customer service representatives to gather quality market intelligence regarding S&OE context.
- It is important to have the effectiveness of the process measured to review the performance and understand how the process in overall can be improved. Hence, there needs to be time allotted for understanding and publishing forecast accuracy, including forecast errors such as MAPE, bias performance and forecast value added during the S&OE weekly sessions.
- It is the responsibility of the Operational demand manager to work on continuous performance optimization that requires in-depth collaboration with all stakeholders of the different regions in order to optimize the performance targets.

Secondly, the Operational demand manager should work on 10% of his time on his task related to global planning and demand management. These are the tasks which are understood by reviewing the current responsibility and conducting interviews with SKF subject matter experts. The tasks are formulated as follows:

- His/her responsibility should be to manage relationships with business and sales/marketing for supply chain agreements, NAR and contract stocks of key customers and inform global planning and demand management for further activities.
- Operational demand manager should also support in demand categorization in providing expertise regarding market specific information.
- Also, the Operational demand manager should also highlight major issues related to network routing to the stakeholders involved in S&OE process, to have control over the network routing.

Lastly, the Operational demand manager should work 5% of his time to gather knowledge related to demand planning and forecasting. As in SKF, the operational demand manager are from the background of inventory manager, it should be stressed to develop an understanding of different demand side related issues and forecasting procedures.

6.2.2 Importance of forecast accuracy and improving demand planning maturity

In response to the problem on managing the KPI of forecast accuracy as mentioned in section 5.4.3 overall, there is a need for a more dynamic and more interactive way which SKF needs to investigate so that an atmosphere is created where discussion between gaps of planned demand and customer orders can be held. The recommendations would reflect on the need to "increase the efforts to educate" the respective stakeholders on the importance of Forecast accuracy. Indicating that all stakeholder although are not accountable for the performance of forecast accuracy are in a way indirectly responsible for increasing the forecasted demand to actual demand as their task is interdependent on the reliability of forecast accuracy. This can be done by not just vaguely communicating the results of forecast accuracy among each other as a whole number but a more "hands-on engagement" with people that feed the forecast upstream in order to supply accordingly (Jordan & Messner, 2020). Therefore, it can be suggested that stakeholders in the S&OE meetings such as inventory manager can directly interact with sales or CSR in order to determine actions together such as reviewing demand of specific SKU's wherein the demand can be resubmitted based on the additional information retrieved, instead of sending across DMI between both demand and supply where sometimes that information would not just be sufficient

to increase the forecast accuracy. This would help SKF shift from enacting forecast accuracy as the responsibility of one person, group, or actor towards understanding the increase in forecast accuracy as collaborative achievement across the organization (Jordan & Messner, 2020). With this recommendation in place, it will offer a better understanding into the use of forecast accuracy as a way to improve the quality of planning.

Apart from that, based on the results of the demand planning maturity assessment as one of the major problems SKF is facing is the different demand patterns received from the larger number of customers, which indeed can be resolved by identifying and classifying different demand streams. SKF can invest in having a process where detailed tailored forecasting techniques are used for different demand streams and in better understanding of the demand drivers. In addition to that, SKF also should work on understanding the forecast accuracy based on industry benchmarks.

6.3 Long term

In this section the description regarding the recommendations which can be fulfilled in long term are explained. This section consists of four recommendations which includes proposals for inclusion of the supply side, future looking S&OE process, incorporating additional technologies to increase and considering demand sensing for forecasting in the short-term horizon.

6.3.1 Inclusion of supply side

One of the gaps identified in the S&OE integration dimension of S&OE maturity model is the poor integration between the demand and supply side for S&OE process. Keeping this thought in mind, recommendations are developed to include the supply side. The idea is to have a look over the supply chain planning matrix and involve the stakeholders in a way by having a vision of "innovative profitable & collaborative operational execution to deliver exceptional customer service".

Considering supply chain planning matrix from Stadtler et al. (2012) which is shown in Figure 28, S&OP is a horizontal collaboration process where the collaboration takes place at a tactical level between the demand and supply side. Comparing S&OE with S&OP, S&OE is also a horizontal process which tries to bridge S&OP plan by collaborating with the demand and supply side on the operational level. Considering this framework, it is ideal to have all the stakeholders from the supply side which includes warehouse replenishment and transport planning and material planning which is explained in the upcoming sections.

Hence, there is a need for a matrix which can easily show the S&OE activities and based on this idea, the matrix was developed as shown in Appendix A. This matrix is divided into pre-S&OE and S&OE. Pre-S&OE includes activities that are done prior to S&OE and S&OE consists of activities in S&OE scope. The pre-S&OE include activities done before S&OE which is not under the responsibilities of the S&OE team. Sales & operations execution activities represent the activities or tasks which should be included under the scope of S&OE. By considering the important aspects of S&OE from different theoretical frameworks and experience from SKF, important categories were developed such as daily activities, KPIs, weekly activities, S&OE meeting, monthly review meeting, decision or plans made through S&OE, outcome of S&OE and finally measuring the effectiveness of the S&OE process.

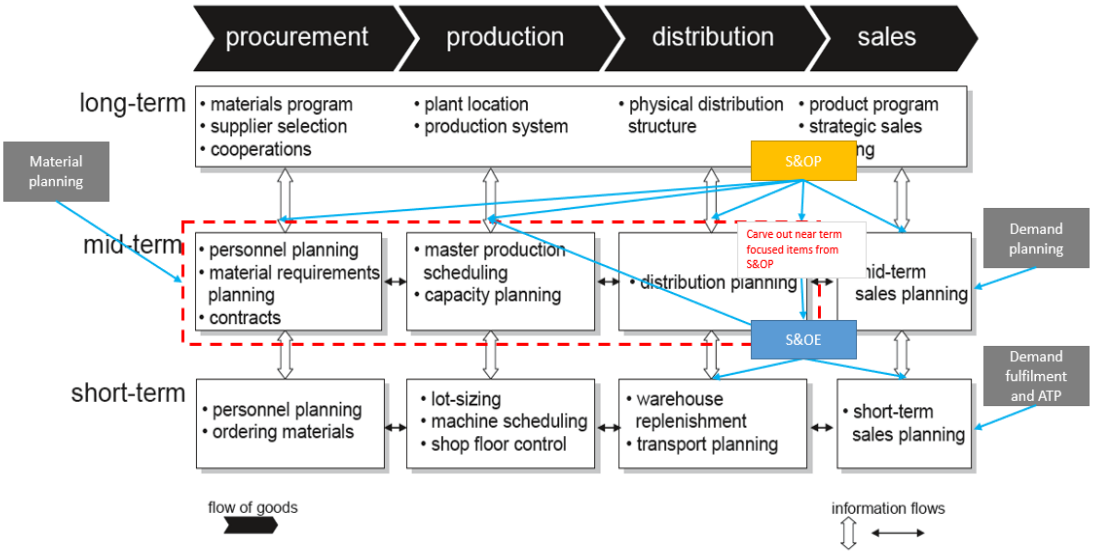


Figure 28: *Supply chain planning matrix. Source adapted from: Stadler et al. (2012)*

Vertically, this Figure 30 in appendix A is divided into activities which pertain to future looking aspects of S&OE and the activities which contribute to understanding of current scenario. Future looking activities are further divided into S&OP plan disaggregation, order book management and forecast consumption report. Current scenario analysis includes supply side abnormalities and demand side abnormalities. Demand side abnormalities includes activities which are done to manage the abnormalities and understanding deviation caused from the demand side (sales, marketing, etcetera). Supply side abnormalities includes activities which are done to manage abnormalities that would appear from supply side, the supply side is further subdivided into transport planning, warehouse management and manufacturing.

Transport planning & warehouse replenishment

An aspect from transport planning & warehouse replenishment can be considered for S&OE process. From an S&OE point of view, these aspects can be segregated into weekly and monthly activities. With respect to weekly activity, the aspects which can be discussed is the increased transport expedites caused from the transport or warehouse replenishment side which are caused due to fluctuations in demand. Also, the impact of the availability failures caused by transport planning and warehouse replenishment due to delayed deliveries or any other reasons can be discussed. In terms of monthly activity, the aspects which can be considered is the review of monthly transport expedites and possibly have a collaborative discussion as to how the transport expedites can be minimized. Also, as a part of S&OE activity, there could also be KPIs from the transport planning side such as delivery performance accuracy which can be discussed. Overall, this leads to reduced transport expedites and contributes to profitability. These reduced transports expedite contributes to lesser environmental impact, ultimately improving the sustainability of S&OE process. Hence, SKF can also view S&OE process which contributes to improved sustainability throughout the organization. The structure as to how these activities need to be aligned with S&OE is shown in Figure 29, the boxes highlighted in red indicate the proposal which can be added in the discussion and boxes in green indicate the already existing activities.

Manufacturing

Another aspect which is proposed is to have the manufacturing also included for the S&OE process. Currently, SKF industrial markets have both “make to order” and “make to stock” stocks which are used to hedge against the demand uncertainties. Also, there is no time fence established for change of plans which means that the short-term changes may not have any major impact to the master production schedules. Hence, SKF can work on establishing the time fence to understand the number of breaches to master production schedule due to the fluctuations of demand in the short term. These impacts of the abnormal demands on production can be discussed in S&OE meeting on a monthly review meeting and decisions related to rescheduling order or adjustment to capacity can also be determined. The monthly review is suggested considering the complexities of SKF supply chain with more than 3 factories globally. The outcome of this activity is the increased visibility and stability to the master production scheduler. The structure as to how these activities need to be aligned with S&OE is shown in Figure 29.

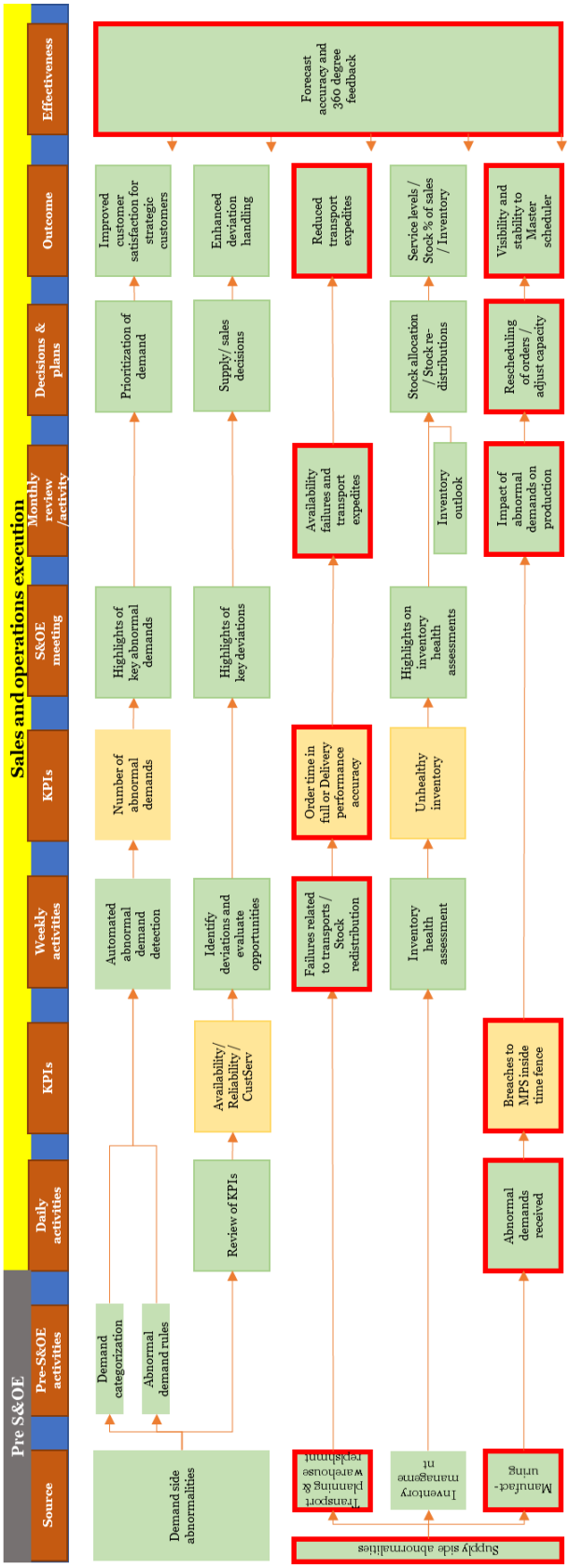


Figure 29: *Demand and supply side activities in S&OE. Source: Author's contribution*

6.3.2 Future looking S&OE process

When looking at the SKF's current S&OE process, it is about the outlook of the current scenario analyzed from KPIs and a backward review process for the demand and supply planning. Hence, there is a need for a future looking process, where the consumption of the demand forecast can be reviewed on a weekly basis. This can be done by disaggregating S&OP plan into a weekly plan which in turn needs to be reconciled with the cleansed sales order received. The sales orders need to be cleansed as there could be many rebooking's, cancellations and postponements by the customers. By comparing the weekly demand forecast against the customer orders received, the consumption of demand forecast can be analyzed to check whether there are any deviations to the planned demand. Further analysis to the deviations will enable to develop an agile response to the short-term changes.

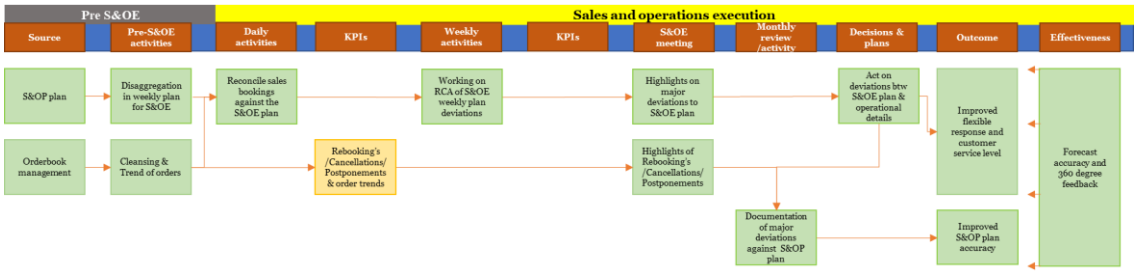


Figure 30: Overview of activities of future looking S&OE. Source: Author's contribution

Figure 30 gives an overview as to how the above-mentioned aspects need to be structured into activities. Firstly, the S&OP plan should be disaggregated into the weekly plan which is checked against the customer orders received. Based on this, the consumption of the S&OP plan is to be checked and the deviations that could happen is analyzed with root cause analysis. If the deviations are major and complex, the demand execution manager/planner needs to highlight in the S&OE meetings and with the consultation of the stakeholders and decision maker for S&OE process, the S&OE plan is decided. For example, if there arises a situation where the demand is greater than supply, then this could be identified from disaggregated plan and could be highlighted in S&OE meeting to make allocation decisions regarding the existing stock. The allocation decision could be the customers who should be prioritized based on the existing customer prioritization rules set by the organization. The outcome of this activity is improved flexible response and increase in customer service level.

Another aspect could be that the facilitator of the S&OE process can have documentation done of major deviations to the S&OP plan that hamper the operations. This also could be highlighted in the next S&OP meeting or inform the S&OP team.

6.3.3 Incorporating additional technologies to increase S&OE maturity

In this section, we will provide recommendations on how to move to next stage in the S&OE maturity model for SKF with respect to first dimension of S&OE maturity model. In the first dimension "meetings and collaboration" it is acknowledged from chapter five that SKF has already obtained quite an advanced stage in the S&OE process where strategic customer data is integrated within SKF's demand chain. Although, Grimson and Pyke (2007) discusses that final stage in the maturity model is quite hard to achieve and for some companies it will always be something to aim for. During this thesis, we have observed and recognized the capability of SKF to move to stage 5 in this dimension by incorporating technologies that provide real-time access to external data which can help different stakeholders in S&OE process to make better decisions faster. Mckinsey (2017) discusses that using machine learning methods such as supervised learning approaches that use Bayesian networks provides access to real-time data. Bayesian network is probabilistic graphical model which can be used to develop models from past data and/or opinion from experts. The Bayesian network not only uses historical sales data to improvise decisions on demand for the future, but it also uses near real-time data to enable accurate and faster decisions among stakeholders. The Bayesian network can be used for tasks such as "predication, anomaly detection, diagnostics, automated insight, reasoning, time series prediction and decision-making under uncertainty" . E.g. availability of real time data enables stakeholders to make faster and better decisions based promotional events, change in prices, customer order patterns etcetera. According to Ostdick (2017), having the access to real time data enables the supply chain partners to have a view of "up-to-the minute" needs of customers which enables them to plan or firefight any bottlenecks that can occur across the supply chain efficiently and effectively. Moreover, access to real time demand can aid supply chain planners in figuring out trends or fluctuations in demand which can hinder production activity and planners are able to make decisions faster on a collaborative basis among other stakeholders to generate accurate and detailed planning for the both medium and short term. Ostdick (2017) also discusses that with the real time information flow supply chain planners and managers will be able to analyze the "up-to-the-minute" data just as it becomes available and then evenly distribute the data to stakeholder in a cross-organizational way to enhance communication and collaboration.

6.3.4 Demand sensing

SKF has already established a good stance in this dimension Information technology. As mentioned in S&OE maturity model SKF has in place an automated abnormal detection tool that automatically detects abnormal orders placed from customers and notifies the respective

stakeholders. A recommendation to obtain an S&OE proactive stage would be to implement the concept of demand sensing. According to an article by Hoey (2018), demand sensing is the utilization of real-time data from downstream actors in the supply chain to generate a dynamic forecast. A more detailed definition would be from Chase & Chase (2016) where demand sensing is the transformation of downstream data with minimal latency in order to comprehend on what item is being sold, which customer is buying the product and how is the product impacting demand. With the concept of demand sensing in place SKF will be able to shift from forecasting based on an old paradigm i.e. generating forecasts for the upcoming months based on previous market behavior of the past years to a new paradigm. Hoey (2018) states that with the concept of demand sensing, Demand planners and Demand managers have the potential to decrease the existing gap between forecasted demand and actual demand.

Demand sensing usually deals with short term demand wherein it considers only one to six weeks into the future. With the technology that operates demand sensing, weekly forecasts on item and location level can be determined using the downstream data of the supply chain to improvise on the short-term execution. It is to be noted here that the short-term operational forecast does not replace the operational demand forecasting but instead it facilitates the operational forecast by providing an insight into real-time consumer demands (Chase & Chase, 2016). Moreover, an additional benefit of using demand sensing is, the short term statistical forecast that is obtained from this concept enables companies to grow their S&OP horizon from short term execution to longer-term operational and strategic planning providing a more rigid plan for the S&OP horizon which SKF is currently implementing globally (Chase & Chase, 2016).

7 Conclusion

In this section, the conclusive comments about the result of the thesis are represented and the research questions are answered. This section will also explain generalizability, limitations and opportunities for future work.

7.2 Summary

From the research experience obtained during the tenure of this thesis it is acknowledged that the process of S&OE has been commonly accepted by many industries as the quickest response to tackle the volatile planning environments. Moreover, the organizations that are using the S&OE process are benefiting on a larger area than anticipated, such as having the ability to look ahead to stabilizing their supply chain. In addition, organizations have even more confidence in the S&OP process due to the existence of S&OE in their organization. Although the industrial market at SKF lacks the complete S&OP process; with the S&OE almost established in the organization globally the executives have firm confidence in completely developing the S&OP process from S&OE. Hence, with the S&OE first implemented the organization required an outside-in perspective on how their S&OE process is working throughout the organization.

While the overall purpose of this thesis is to contribute to theory on the topic of S&OE, the case study at SKF has greatly enhanced the study of this thesis from a practical standpoint. Hence, by collaborating with SKF, the purpose of this thesis was narrowed down to evaluate the S&OE process at SKF and to improve the capabilities of the S&OE process based on a qualitative study. Through a collection of both primary and secondary data and using the abductive methodology the S&OE process at SKF was evaluated.

To answer the first research question "What are the characteristics of S&OE process at SKF?", the formalized S&OE model developed by Carvalho (2018) is used to compare the characteristics of S&OE at SKF. Table 7 under section 5.1, distinguishes the characteristics between theory and practical implementation. The intent of answering this research question is to give a summary of the important characteristics which SKF should consider when implementing and increasing the maturity of the S&OE process. This would enable the case company to get an outside-in perspective on how well the process has been set up according to theory which avoids a biased view for the company. This question is answered in section 4.3, 4.4 and 5.1.

The research question two on “How is the SKFs S&OE process designed with respect to workflow and are the roles and responsibilities correctly set for the process?” , is answered by observing the workflow of S&OE process and using the BPMN model in section 4.4.1 to give theoretical explanation of the process at SKF. Followed by which, the roles and responsibilities of stakeholders are identified using the RACI matrix in section 5.2. With respect to the roles and responsibilities of stakeholders, emphasis is given to the Operational demand manager as that person is the facilitator of the S&OE process. Hence, the intention here was to appropriately set the roles and responsibilities of the Operational demand manager so that the S&OE process can be efficiently performed. Further analysis and research are done with a more practical standpoint. The results of the final roles and responsibilities Operational demand manager is stated in section 6.1.1.

The research question three on “What are the contextual factors affecting the S&OE process at SKF and how can the maturity of the S&OE process be assessed.?”, is answered by referring to the S&OP and S&OE literature. First, the planning environment affecting the business is determined by using the contingency theory from Ivert et al. (2015). The contextual factors obtained from this theory are then used to develop a S&OE maturity model by adapting the dimensions from the Grimson and Pyke (2007) maturity model. The contingency theory is presented in section 5.3 and the S&OE maturity model adapted from Grimson and Pyke (2007) is presented in section 5.4. In addition, considering the S&OE maturity model developed in this paper, future recommendations are provided focusing on short-term and long-term described in the previous section.

It is to be noted here that the answers provided to RQ’s one and two are primarily the analysis itself presented in this thesis. This is because the reasons for implementing the S&OE process varies depending on the industry, hence, previous case studies of S&OE in this industry are unavailable which prevented us from conducting a cross-case analysis. Moreover, this paper is a theoretical contribution to the topic of S&OE, therefore, with the analysis presented as the answers to RQ one and two organizations in a similar context can refer to this thesis to determine their workflow and characteristics.

7.3 Generalizability

Generalizability explains the extent to which the findings and conclusions of the study can be applied to a larger population. The thesis is considered to contribute to both theory and practitioners on the topic of sales and operations execution. Information on the characteristics of S&OE is compared from a theory and a practical standpoint. This enables other organization

executives to easily compare and determine the right characteristics of S&OE for their organization.

When looking at the S&OE maturity model, it was customized to SKF context. Hence, the results of this thesis are useful for the companies under similar context as SKF. Although, it is quite rare that some might start with an S&OE process first rather than an S&OP process, companies with similar context can use this to initiate, evaluate and improve their S&OE process.

7.4 Limitations

In this section the limitations which were not under our control are described. Regarding limitation, there is limited academic literature related to S&OE and most of the information regarding S&OE process had to be referred from consultancies white papers. Secondly, the COVID-19 pandemic had a major impact during the thesis conduction as it delayed the primary and secondary collection required for the conduction of research. Hence, some delimitations had to be set for the study in order to accomplish study within the stipulated time of 4 months.

7.5 Future research areas

S&OE process has a good scope in future with many companies wanting to work on an agile plan by translating tactical plans developed into the details and forming the bridge between S&OP and operational execution. This thesis serves an important contribution towards developing a theoretical stance towards S&OE process. One of the future areas to work on an S&OE maturity model developed based on exploratory research, so that a generalized S&OE maturity model can be developed which can be used by companies under different contingencies. Another is related to how the S&OE process could evolve with different industry 4.0 technologies.

References

Adams, J., Khan, H.T.A., & Raeside, R. (2014). *Research Methods for Business and Social Science Students*. New Delhi: SAGE Publications.

Anthony, R. N. (1965). Planning and Control Systems: A framework for analysis. Boston: Division of Research, Graduate school of Business administration, Harvard University.

Bagni, G., & Marçola, J. A. (2019). Evaluation of the maturity of the S&OP process for a written materials company: a case study. *Gestão & Produção*, 26(1), 1-15

Bayes Server Limited (2018). *Bayesian networks - an introduction.* available at: https://www.bayesserver.com/docs/introduction/bayesian-networks (accessed on May 30, 2020)

Bell, E., Bryman, A., & Harley, B. (2019). *Business research methods*. Oxford: Oxford University Press.

Bower, P. (2018). S&OP, Demand Control, and Quick Response Forecasting. *Journal of Business Forecasting*, 37(2), 10-13.

Carvalho, A., L., D. (2018). The intermediate link in planning: a multicase study of the Sales and Operations Execution process. (Master's thesis, University of São Paulo, São Paulo), available at: https://www.teses.usp.br/teses/disponiveis/18/18156/tde-16072018-100932/publico/AnaLimadeCarvalhoDEFINITIVO.pdf

Chainalytics. (2019). Sales and operations execution: Bridging tactical S&OP and operational execution. available at: https://www.chainalytics.com/: https://www.chainalytics.com/wp-content/uploads/2019/09/Chainalytics-Sales-Operations-Execution-SOE-Guide_Web.pdf (accessed on January 30,2020)

Chase, Jr. C., & Chase, C. W. (2016). *Next Generation Demand Management. People, process, analytics, and technology*. John Wiley & Sons, Incorporated

De Bruin, T., Freeze, R., Kulkarni, U., & Rosemann, M. (2005). Understanding the Main Phases of Developing a Maturity Assessment Model, In Bunker, D, Campbell, B, & Underwood, J (Eds.) Australasian Conference on Information Systems (ACIS). Australasian Chapter of the Association for Information Systems, CD Rom, 8-19

Esper, T., Elinger, A., Stank, T., Flint, D., & Moon, M. (2009). Demand and supply integration: a conceptual framework of value creation through knowledge management. *Journal of the Academy of Marketing Science*, 28, 5-18.

Gianesi, I. (1998). Implementing Manufacturing strategy through strategic production planning. *International Journal of Operations and Production Management*, 18(3), 286- 299.

Grimson, J., & Pyke, D. F. (2007). Sales and Operations Planning: an exploratory study and framework. *The International Journal of Logistics management*, 18(3), 322-346.

Hippold, S. (2019). *How to set up S&OE in supply chain planning*, available at: https://www.gartner.com/smarterwithgartner/how-to-set-up-soe-in-supply-chain-planning/ (accessed February 5,2020)

Hoey, B. (2018). *How is S&OE Different from S&OP?*, available at: https://blog.flexis.com/how-is-soe-different-from-sop (accessed on January 30,2020)

Holmes, D. (2015). *Demand Control Webcast*, available at: https://www.oliverwight-americas.com/videos/demand-control-webcast/ (accessed on February 5, 2020)

Inc. Oliver Wight International. (2017). *The Oliver Wight Class a Standard for Business Excellence*. John Wiley & Sons, Incorporated.

Ivert, L. K., Popovska, I. D., Fredriksson, A., Dreyer, H., & Kaipia, R. (2015). Contingency between S&OP design and planning environment. *International Journal of Physical Distribution and Logistics Management*, 45(8), 747-773

Jonsson, P., & Mattsson, S-A. (2009). *Manufacturing planning and control*. McGraw-Hill Education, London.

Jordan, S., & Messner, M. (2020). The Use of Forecast Accuracy Indicators to Improve Planning Quality: Insights from a Case Study. *European Accounting Review*, 29(2), 337-359.

Kallio, H., Pietilä, A-M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: Developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing*, 72(12), 2954-2965.

Kantor, B. (2018). *The RACI matrix: Your blueprint for project success*. available at: https://www.cio.com/article/2395825/project-management-how-to-design-a-successful-raci-project-plan.html (accessed on May 10, 2020)

Kelber, J. (2020). *How Should Planners Measure S&OE Success?*, available at: https://blog.flexis.com/planners-measure-soe-success (accessed on February 20, 2020)

Kothari, C. (2004). *Research Methodology: Methods and Techniques*. Jaipur, India. New Age International Ltd.

Kovacs, G., & Spens, K. M. (2005). Abductive reasoning in logistics. *International Journal of Physical Distribution & Logistics Management*. 35(2), 132-144

Kristensen, J., & Jonsson, P. (2018). Context-based sales and operations planning (S&OP) research: A literature review and future agenda. *International Journal of Physical Distribution & Logistics Management*, 48(1), 19-46.

Lapide, L. (2004). Sales & operations planning part I: the process. *Journal of Business Forecasting*. 23(4), 18-20.

Lapide, L. (2005). Sales & operations planning part III: a diagnostic model. *Journal of Business Forecasting*, 24(1), 13-16.

Lapide, L. (2011). S&OP: The Linchpin Planning Process. *Journal of Business Forecastin*g, 30(3), 18-20.

Lim, L., Apan, G., & Penz, B. (2014). Reconciling sales and operations management with distant suppliers in automotive industry. *International Journal of Production Economics*, 151(1), 20-36.

Lindsey, P. (2019). *Minimizing Chaos with Demand Control and Execution*, available at: https://www.oliverwight-americas.com/videos/minimizing-chaos-with-demand-control-and-execution/ (accessed on January 30, 2020)

Ling, R.C., & Goddard, W.E. (1988). *Orchestrating Success: Improve Control of the Business with Sales and Operations planning*. Essex Junction, VT. Oliver Wight Ltd. Publications

McKinsey. (2017). *Smartening up with artificial intelligence (AI)- what's in it for Germany and its industrial sector?* available at: https://www.mckinsey.com/~/media/McKinsey/Industries/Semiconductors/Our%20Insights/Smartening%20up%20with%20artificial%20intelligence/Smartening-up-with-artificial-intelligence.ashx (accessed on May 30, 2020)

Nevin, M. (2014). *The strategic Alliance Handbook: A practitioner's guide to business-to-business collaborations*. London & New York: Taylor and Francis Group.

Object Management Group (OMG). (2011). Business Process Model and Notation (BPMN), available at: http://www.omg.org/spec/BPMN/2.0. (accessed on February 10, 2020)

Ostdick, N. (2017). *The Importance of Real-time in the Supply Chain*, available at https://blog.flexis.com/the-importance-of-real-time-in-the-supply-chain#:~:text=Demand%20insight%20and%20visibility,bottlenecks%20across%20the%20supply%20stream (accessed on April 24, 2020)

Palmatier, G., & Crum, C. (2003). *Demand Management Best Practices: Process, Principles, and Collaboration.* J. Ross Publishing. Florida

Pukkila, M. (2016). *Set Up Sales and Operations Execution Process to Support the S&OP Cycle*. available at: https://www.gartner.com/en/documents/3193018/set-up-sales-and-operations-execution-process-to-support (accessed on February 1,2020)

Shaikh, S. (2018). *Supply chain times: Untangling S&OP and S&OE*, available at: https://sctimes.io/news/article/7/5232 (accessed on February 4, 2020)

SKF Group. (2019). *Annual report 2019*, available at: https://investors.skf.com/sites/default/files/pr/SKF_AR19_ENG_bookmarks_.pdf (accessed on February 1, 2020)

SKF. (2020). *Products: Angular contact ball bearings*, available at: https://www.skf.com/us/products/rolling-bearings/ball-bearings/angular-contact-ball-bearings#cid-464559 (accessed on February 26, 2020)

Smaros, J., Lehtonen, J.-M., Appelqvist, P., & Jan, H. (2003). The Impact of Increasing Demand Visibility on Production and Inventory Control Efficiency. *International Journal of Physical Distribution & Logistics Management*, 33(4), 336-354.

Stadtler, H., Fleischmann, B., Grunow, M., Meyr, H., & Sürie, C. (2012). *Advanced Planning in Supply Chains*. Verlag Berlin Heidelberg: Springer.

Thome, A.M.T., Scavarda, L.F., Fernandez, N.S., Scavarda, A.J., (2012). Sales and operations planning: : a research synthesis. *International Journal of Productivity and Performance Management*, 138(1), 359-381.

Van Looy, A., De Backer, M., Poels, G., & Snoeck, M. (2013). Choosing the right business process maturity model. *Journal on Information & Management*, 50, 466–488.

Vereecke, A., Vanderheyden, K., Baecke, P., & Van Steendam, T. (2018). Mind the Gap-Assessing maturity of demand planning, a cornerstone of S&OP. *International Journal of Operations & Production management*, 38(8), 1618-1639.

Wallace, T.F., & Stahl, R.A., (2008). *Sales and operation planning: The how-to handbook*. T. F. Wallace and company

Yeung, H.W-c. (1995). Qualitative personal interviews in international business research: Some lessons from a study of Hong Kong transnational corporations. *International Business Review*, 29(1), 333-339.

Appendix A

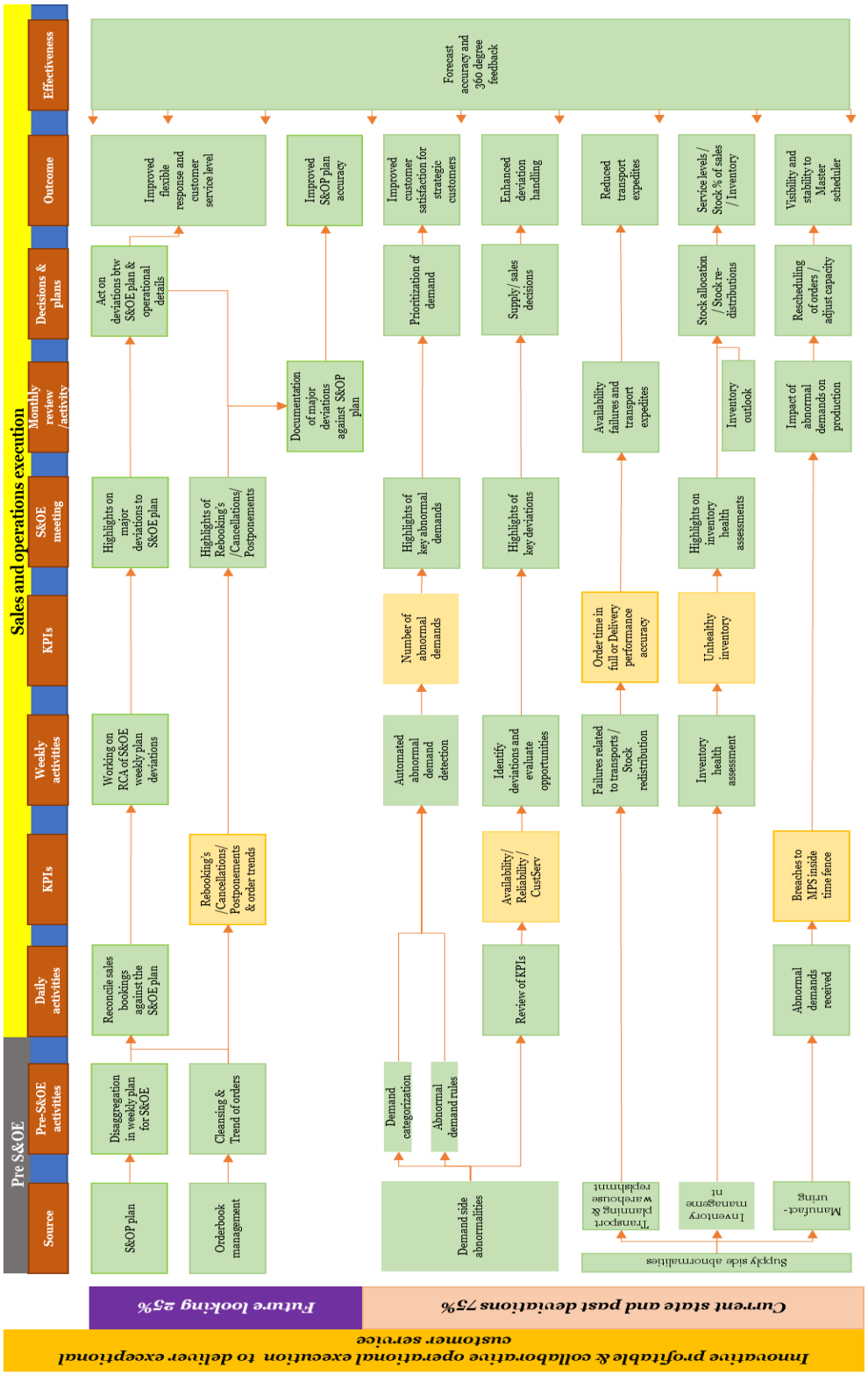


Figure 31: *Overview of S&OE activities. Source: Author's contribution*

Appendix B

Question related to background

1. Can you explain about SKF's current supply chain?
2. What type of markets do you serve? B2B? B2C?
3. What are the different products? Who are the main customers?
4. Can you explain why the S&OE process was initiated at SKF?
5. Can you explain me about the S&OE process implemented?
6. How is S&OE process defined by SKF?

Question related to S&OE process

1. What are the activities done in S&OE process?
2. What are the inputs and outputs for the S&OE meeting?
3. What are the tools and technologies used by companies in S&OE process?
4. What are the key performance indicators used in S&OE process?
5. How is the S&OE process effectiveness measured?
6. Is scenario analysis done in S&OE process?
7. What is the planning horizon and detail hierarchy for the S&OE process?
8. What are the decisions made in S&OE process? Who is the decision make in S&OE process?

Question related to organization and stakeholders

1. Who are the stakeholders involved in S&OE process? Is demand side included? Is supply side included?
2. Is there any dedicated team for S&OE process?
3. Who is the facilitator of S&OE process? What are the roles and responsibilities of S&OE team involved in S&OE process?
4. How are the decision made? Who makes the decision?