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Development of a Sales and Operations Planning process

A multiple case study of suppliers in the automotive industry

Master of Science thesis

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ABSTRACT

Even though the Sales and Operation Planning (S&OP) concept have been around for a while it is still considered to be an increasingly important planning process in all types of businesses. Increased complexity within today's supply chains and uncertainties in market demands are clear motives for this common view. S&OP supports the cross-functional work of developing and accepting a common operating plan. Potential benefits to gain from an S&OP process are among others improved profitability, inventory levels, on time deliveries and manufacturing downtime, due to an optimized balance of demand and supply. The fierce competitiveness within the automotive industry increases the need of effectiveness and waste reduction throughout the whole supply chain, which has become of even more importance since the economic downturn. Poor forecasting and planning processes must be improved in order to survive.

This thesis is a part of a bigger project initiated by Odette Sweden and Nätverk för affärsutveckling inom försörjningskedjan (NAF), where the main purpose is to improve the forecast accuracy within the automotive supply chain. S&OP has from that project been identified as one action to mitigate the consequences of the poor forecasts sent from the OEMs to the suppliers. The aim of this thesis is thereby to develop guidelines for how an S&OP process for small to medium sized suppliers in the automotive industry should be structured. The purpose is broken down into three research questions (RQ). RQ1 is defined to map the investigated companies' current planning processes and S&OP maturity into a framework in order to access their current situation. RQ2 is related to the FAI Analyzer tool and what use the tool can have within an S&OP process. The last question is to, from the previous answered RQs, develop recommendations for how the S&OP process should be performed for companies within the specific context.

From the analysis it is concluded that few companies within this specific context have a pronounced S&OP process even though some parts of the process are performed as of today. The steps of long-term capacity checks, cross-functional plan integration and measurement of forecast quality can be regarded as most lacking within these companies. The level of maturity of the S&OP process is consequently low with limited awareness about the S&OP process. Regarding the FAI Analyzer tool, it is concluded that the tool in some cases is useful for the S&OP process, since it can improve the forecast quality by identifying systematic errors in the delivery plans sent from customers. Further, the tool can give some indications about how flexible the production capacity has to be.

The main result of this thesis is concise recommendations for how the different steps within the S&OP process can be performed, i.e. "Create initial demand plan", "Create initial production/supply plan", "Create consensus plan", "Implement the plan" and "Measure the plan". Companies following these guidelines are believed to reach the third stage in the S&OP maturity framework.

Keywords: Sales and Operations planning (S&OP), S&OP maturity, forecast accuracy, automotive industry, automotive suppliers, FAI Analyzer tool

ACKNOWLEDGEMENTS

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Lastly, we would like to direct many thanks to all employees at Meridion for your great support throughout this whole time. Your positive encouragement has meant a lot to us.

Gothenburg, December 2014

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Ebba Karlsson Annie Ragnarsson

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1. Introduction

In this chapter an introduction to the thesis is provided. This includes both theoretical and corporate background as well as problem analysis that will motivate the reason for why this master thesis is conducted. Further are the purpose and more specific research questions stated. In the end of the chapter delimitations is defined and a thesis structure is presented where the different chapters and their contents briefly are described.

This master thesis is conducted at Meridion in cooperation with a number of suppliers within the Swedish automotive industry. The aim with this master thesis is to map the current planning processes at the chosen suppliers and develop recommendations for the Sales and operations planning (S&OP) process given the suppliers specific context. What use the Odette FAI Analyzer can have for the suppliers in their S&OP process will also be investigated.

1.1 Theoretical background

Today companies face a tougher environment with fierce global competition, increased customer expectations, and fast technological advances (Vokurka et al., 2002). However many companies have managed to enhance their internal operations, by improving their product quality while lowering costs, (Vokurka et al., 2002) and make advancement within supply chain integration (Grimson & Pyke, 2007). At the same time sales and marketing have made progress in understanding customers' preferences, which leads to greater revenues (Grimson & Pyke, 2007).

Even though there are still possibilities to reduce costs in operations and increase sales the most interesting opportunities seems to appear in the linkage of these two objectives according to Grimson and Pyke (2007) where the obvious goal is profit optimization. A concept that offers this opportunity is Sales and operations planning (S&OP) which is a tactical long term planning process that aims to reconcile contradicting business objectives, i.e. reduce costs while increasing revenues, by balancing demand and supply, and working out future plans of action (Jonsson & Mattsson, 2009). Top management and different business functions, such as sales, operations and finance are involved in the S&OP process and collaborate to find a single plan to agree upon that can be used to drive the whole company. The goal of finding a good balance between demand and supply (see Figure 1) is to optimize the efficiency of the company and increase its competitiveness. Possible consequences that may occur if this balance between demand and supply is not reached are loss of sales, decreased delivery capacity to customer, increased stocks and higher unit production costs among others (Jonsson & Mattsson, 2009).

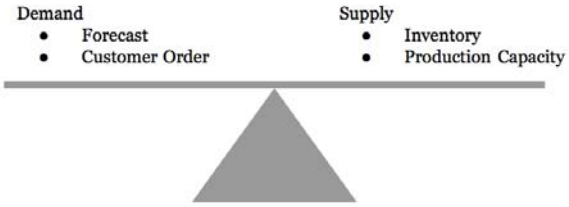

Figure 1. The Balancing between demand and supply (After Jonsson & Mattsson, 2009, p. 162)

Although S&OP offers great opportunities for companies many does not take full advantage of it according to Schlegel and Murray (2010). S&OP is often thought of as distant and abstract and those who need it the most are too busy tackling problems with their current planning processes, if planning at all (Dwyer, 2000). Another possible reason for why companies do not use S&OP to a greater extent can, according to Grimson and Pyke, be the difficulties with the implementation of the process in the business. S&OP demands cross-functional cooperation and departments with different objectives have to collaborate and work towards a common goal. Furthermore must the entire company culture change, it is not enough to solely alter the business process itself (Grimson & Pyke, 2007).

The sales and operations planning process is most commonly divided into five steps that are executed on a monthly basis (Tudorie & Borangiu, 2011). The process structure is described by a number of different authors (Grimson & Pyke, 2007; Jonsson & Mattsson, 2009; Tudorie & Borangiu, 2011). There are however some differences in how it is described, what is included and where the focus is. Nevertheless, the main steps most often included are; creating a future demand forecast and a supply plan and develop and establish a final operating plan (Grimson & Pyke, 2007; Jonsson & Mattsson, 2009; Tudorie & Borangiu, 2011).

The planning horizon for S&OP is long term and typically spans over 18 months (Dwyer 2000; Grimson & Pyke, 2007; Tudorie & Borangiu, 2011) but there are also cases where the planning horizon exceeds three years (Jonsson & Mattson, 2009). Selecting time horizon is an important decision and factors that may influence this decision are type of industry, product seasonality and what time of the year that the S&OP planning takes place (Grimson & Pyke, 2007). In order to not have to develop forecasts for every single product, S&OP are most commonly used on product families (Dwyer, 2000) however according to Grimson and Pyke (2007) it sometimes occur that companies apply S&OP on stock keeping units (SKU) as well.

The characteristics of the planning environment are also of significant importance for the appropriateness of a planning method, as stated by Jonsson and Mattsson (2003). The planning environment can be related to a number of variables that describes the product, the demand as well as the manufacturing process. Olhager and Rudberg (2002) have also investigated the linkage between market characteristics, product specifications and process choice to the manufacturing planning and control systems. They concluded that market requirements (demand) as well as the product characteristics are the most important factors when designing a long term planning process, such as the S&OP process. The demand related variables include order volume and frequency of orders, independent or dependent demand, demands from forecast or from customer order allocations, etc. The product characteristics relates to bill of material (BOM)-complexity, product variety, customization, etc. (Jonsson & Mattsson, 2003).

1.2 Corporate Background

The European automotive industry is suffering from poor forecasting and planning processes that aims to predict the demand of assemblies and parts from suppliers (Odette, 2013). Odette (2013) is stressing the problems of these inaccurate forecasts or delivery plans sent from big OEMs to their suppliers, which have become of even more significance since the economic downturn. The low quality of the forecasts are causing great waste in the automotive industry, something that needs to be eliminated in order to survive in such a competitive market, especially since supply chains are becoming more complex and globalized (Odette, 2013).

The inaccuracies of the forecasts that are being sent from OEMs to the tier 1 suppliers are usually becoming even more fluctuating as the information is sent upstream to the different tiers within the supply chain. This phenomenon is called the “bullwhip effect” and will have a great influence on the smaller suppliers ability to respond efficiently to real changes in demand (Chopra & Meindl, 2007).

Odette Sweden, which is a member-funded organization that develops recommendations and standardizations for the automotive industry, is involved in a project that aims to improve the forecast accuracy within the automotive industry. The main goal of the project is to find patterns and systematic errors that influence fluctuation in demand and from that develop actions to improve the flow throughout the whole supply chain. Within this project, a network of companies and organizations from the Swedish automotive industry, *Nätverk för affärsutveckling inom försörjningskedjan (NAF),* are involved. This network includes large OEMs, but also small tier 1 and tier 2 suppliers. Meridion, where this thesis will take place, functions as the project manager within this project.

One part of the project was to develop a measurement tool in order to be able to measure the quality of the forecasts (delivery plans) in the automotive supply chain. From this, a tool, *Odette FAI Analyzer*, was developed in Qlikview, a business intelligence software. This tool measures how accurate the delivery plans are compared to the final orders from the customers. The comparison can be made at different time horizons, and thereby show how the forecasts are changing, as the order date gets closer. The output from the tool are two different KPIs, Forecast Accuracy Index, (FAI) and Weighted Tracking Signal (WTS), which both are developed and defined by Odette International in cooperation with a number of European OEMs and major suppliers. The FAI gives a percentage of the deviation between the forecast at a specific time and a reference demand that usually is set to the actual firm order. The WTS shows whether the forecast tend to be higher or lower than the final order.

This tool has been implemented at some companies within NAF and a first analyze have been made locally. This has shown that the quality of the forecasts generally tends to be quite low, resulting in increased difficulties for capacity as well as demand planning at the suppliers.

The next phase of the project is to try to identify why the quality of the forecasts is as low as it is, and take actions on how to reduce the consequences of the inaccuracies. One part of this will include how the companies are and should work with their planning processes, where this thesis will focus on the S&OP process for Tier 1 and Tier 2 suppliers.

The suppliers that are to be investigated are 6 different small to medium sized companies that supply directly to OEMs or Tier 1 suppliers within the automotive industry, that doesn’t have a formalized S&OP process as of today. Further, one additional company that doesn’t fit the reference group due to its size and already well-developed S&OP process will be investigated. This company will thereby function as a source of inspiration within this project.

1.3 Problem Analysis

As stated in the background influences the high level of uncertainties of the delivery plans from the OEMs to the suppliers the complexity of the planning processes at the suppliers. The suppliers are at current somewhat aware of the low accuracy that the delivery plans tend to have, especially on a long-term horizon. How this problem is managed is thereby of great concern for the companies’ performance, in the matter of balancing supply and demand for the long term horizon. Not having a sufficient planning

process that aims to balance demand and supply in an adequate way can have a high influence on the performance of the suppliers. In the case where demand exceeds supply there is a risk of poorer delivery service to customers, including lower service level in the case of make to stock and longer delivery lead times in the case of make to order (Jonsson & Mattson, 2009). Furthermore, this unbalance may lead to increasing costs due to overtime in production or higher freight costs related to express deliveries (Jonsson & Mattson, 2009). On the other hand, where the capacity is higher than demand there is a risk of increased stocks, which implies high levels of tied up capital as well as high storage costs. Furthermore, having more capacity than demand increases the unit production costs due to low utilization of machines and labor (Jonsson & Mattson, 2009).

As of today the suppliers do not have a stated S&OP process, while some may use a combination of S&OP and Master Production Scheduling (MPS). Since there is no stated standardized approach within these companies regarding their long term planning processes it is important to first investigate what their planning processes look like today and with this as a basis investigate how they can be improved.

1.4 Purpose

Develop recommendations for how suppliers in the automotive industry should perform their S&OP process taking into consideration the specific company context.

1.5 Research questions

From the problem definition and the purpose, three research questions (RQ) are formulated:

RQ1. What gaps exists between the S&OP literature and automotive suppliers' current S&OP processes?

RQ2. What use can *Odette FAI Analyzer tool* have for the suppliers in their S&OP process*?*

RQ3. How can recommendations for the S&OP process be designed for suppliers in the automotive industry, based on the identified gaps?

1.6 Delimitations

The focus of this thesis is to develop guidelines and recommendations for what an S&OP process should include for companies within this particular context. However, clear instructions for how these steps should be performed for each individual company are delimited from this project.

Further, the recommendations are given without any prioritization regarding when they should be implemented and in what order. Which dimensions that should be prioritized in what order, regarding the S&OP maturity, is also delimited from this project.

1.7 Thesis structure

In the following section is the structure of the thesis presented and a brief description of the content of each chapter is stated.

1. Introduction
In this chapter an introduction to the thesis is provided. This includes both a theoretical background to the S&OP concept and a corporate background as well as the problem analysis that will motivate the reason for why this thesis is conducted. Furthermore, the purpose and research questions are stated together with the delimitations made for this thesis.

2. Methodology
The aim with this chapter is to describe the methodology used throughout the study in order to answer the stated research questions and thereby fulfill the purpose of the thesis. Thus a description of the research design, model of analysis and the methods used for the data collection is given.

3. Theoretical framework
This chapter presents the theoretical framework, which is the basis for the whole study, created from the literature review. A deeper description of sales and operations planning and its main elements is followed by a section regarding the S&OP maturity framework. Further is the FAI analyzer tool described.

4. Empirical data
In this chapter the gathered data is presented, starting with the case descriptions where the investigated companies and their planning processes are presented. Furthermore, data from the conducted survey as well as the results from the workshop is given.

5. Analysis
The analysis of the empirical data against the theoretical framework is presented in this chapter and the three pre-stated research questions are answered. Thus this chapter contains firstly a mapping of the companies' current S&OP processes and an identification of gaps compared to the theoretical framework followed by suggestions on how the FAI analyzer tool can be used in the S&OP process and lastly guidelines for how to design and perform an S&OP process for the given context is presented. A discussion concerning the interpretation of the results is also given within the analysis.

6. Recommendations
In this chapter, concise recommendations for how each step in the S&OP process could be performed by suppliers in the automotive industry are presented.

7. Conclusions
This chapter concludes upon the major findings of the thesis and explains how the stated research questions have been answered. It further contains propositions of areas for further research as well as the contribution of the thesis, both for practitioner and theory.

2. Methodology

In this chapter the methodology used throughout the study is presented by describing the research design, model of analysis and the methods used for data collection. The focus of this thesis is small and medium sized suppliers within tier 1 and 2 in the Swedish automotive industry, from where the empirical data is gathered and analyzed.

2.1 Research design

The thesis is structured so that a reference group of seven companies within the NAF/Odette project is investigated, where a rough selection is made based on similarities in company size and complexity. The defined reference group, i.e. companies within the NAF/Odette project, is mostly operating within the Swedish automotive industry. Due to the fact that several companies are examined and compared within this thesis a multiple case study is chosen as the research design. A multiple case study is appropriate when the numbers of companies that will be investigated are more than one (Bryman & Bell, 2003).

2.2 Model of analysis

In order to get a clearer overview of the ongoing work and methods used throughout this thesis an analysis model is used. This model is structured around the stated research questions in a step-by-step approach and is further described in Figure 2 below.

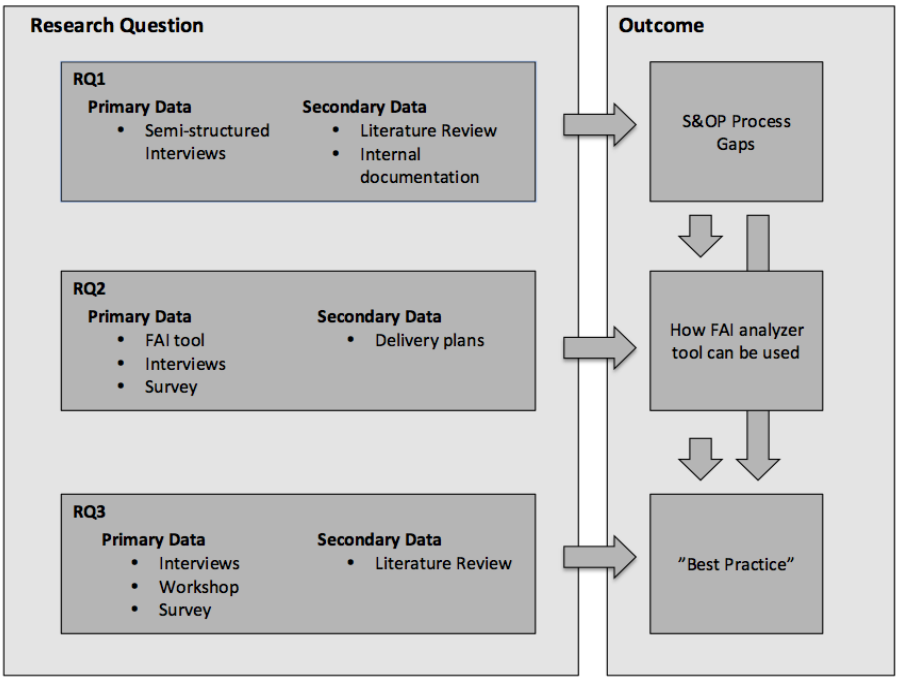

Figure 2. Model of analysis

2.2.1 Research question 1- Identify gaps between literature and current S&OP processes

Create theoretical framework

First, secondary data is gathered through a literature review that is performed with focus on planning processes in general and S&OP processes in particular. The literature is the basis for understanding how an S&OP process should be structured and what steps that should be included. From this, a framework of the S&OP process structure is developed, which is applied in order to identify the companies' current S&OP processes. Furthermore, a maturity framework regarding the S&OP process is identified and then used for mapping the companies that are investigated, into different levels of maturity.

Data Gathering

The methods used, in order to gather the primary data needed for the analysis, are firstly semi-structured interviews in order to understand the companies' current situations, regarding their planning activities. The focus of the interview is to get some general information about the company and its context, including their products, customers, suppliers as well as their manufacturing process. Further on, questions regarding their current planning process are handled. These questions include how their forecasting process looks like today, what people that are involved in the process, what planning parameters are used, etc. Lastly, questions regarding the FAI analyzer tool, and how it is used, are investigated. Internal documentation of the companies' current planning processes is used as complementary data in the cases where it exists.

Map suppliers into the framework and identify gaps

The documented data from the interviews and possible internal documentation is used in order to identify what process steps the suppliers conduct and which they are missing, according to literature, in their current planning processes. These missing steps thereby represent the gaps. Furthermore, in order to access how mature their processes are today the data is mapped into the identified maturity framework. Here, gaps in process maturity can be identified.

2.2.2 Research Question 2 - What use the *Odette FAI Analyzer* can have for the S&OP process

Gather input on how the FAI analyzer tool can be used

The main input to recognize the potential usage of the FAI analyzer tool in the S&OP process is data collected from the suppliers during the first initial interviews as well as the workshop. This workshop is held together with all involved suppliers where the findings from RQ1 are presented. This is used as an input to get feedback from the suppliers regarding both the use of the FAI Analyzer tool and how they believe an S&OP process should be structured. A survey is sent out as a preparation for the workshop. This contains questions mainly regarding different kind of difficulties and consequences of current planning processes, but also questions regarding the FAI Analyzer tool.

Get familiar with the Odette FAI Analyzer tool

An introduction demo is held by Meridion in order to get a first introduction of the tool. Furthermore, some self study sessions are necessary to get a full understanding of the tool and its potential. Analyzes

with real data, i.e. delivery plans from the investigated companies, are performed in order to gain a more comprehensive understanding about the companies' situations.

2.2.3 Research question 3 - Develop recommendations for the S&OP process

Create S&OP process recommendations

The last step is to develop recommendations regarding the S&OP process by the help of previous work. This includes recommendations regarding what S&OP process steps that should exist and how they should be performed, i.e. which gaps that should be filled. The input from the workshop gives a better understanding of the expectations of the companies and what steps they consider are the most important but also what maturity level they find appropriate for their context. In order to have a basis for the workshop discussions and a more comprehensive understanding for what problem areas that are most crucial for the suppliers, a survey with statements regarding their planning processes and possible consequences is sent out in advance. The literature review is also an input on how to structure an S&OP process. Some considerations regarding companies' specific planning environment is given, since possibilities and prerequisites may differ for the different suppliers.

In order to identify how to best design the planning parameters in the S&OP process input is used from both the initial interviews and the workshop that is conducted in cooperation with the NAF/Odette project group. The parameters to investigate are planning frequency, planning object, capacity unit and planning horizon.

2.3 Data collection

The data collection is an important part of the thesis since it will be the basis for the analysis and accordingly essential for the final results. The collected data is divided into primary and secondary data. The methods used and the data collected are described in the sections below.

2.3.1 Primary data

Semi structured interviews

The interviews conducted at the suppliers, in the beginning of the thesis work, are of a semi-structured nature. For a semi-structured interview the interviewer prepares a list of questions, in an interview template, with the topics that he or she wishes to get answers to (Bryman & Bell, 2003). However, the interviewee has a great deal of freedom in how to answer and the questions may not be answered in the order decided in the template. Spontaneous questions, not listed in the interview template, may also be asked by the interviewer in order to get a deeper explanation of something the interviewee has said (Bryman & Bell, 2003; Björklund & Paulsson, 2012). The main rationale for this approach is that the topic covered during the interview is predefined. However, due to the fact that the planning processes may be structured differently at the companies increases the necessity to give the interviewee some leeway when describing their process. This method also allows follow up questions that may be difficult to formulate on beforehand.

The data collected from the initial interviews is of great importance since it is the main input for understanding the suppliers' current processes and company environments, which is necessary to be able to answer foremost RQ1 but also RQ2 and RQ3. The data collected primarily concerns information about the supplier's planning process for example regarding how the demand is forecasted, how production plans are developed, and the measurements applied in connection with the planning process etc. Also general information about the company regarding customers, products, suppliers and production process, is collected as well as information about their usage of the FAI tool. The interview template, with the predefined questions, is found in Appendix 1. The interviews are most often conducted at the suppliers, with exception for one interview done via a web meeting. The interviews are recorded and afterwards documented. The person being interviewed is the logistic manager or similar at the company. In some cases, others from the company attend the interview as well, including representatives from production and purchasing. The list of the interviewees can be found in Appendix 2.

Survey

Advantages of using a survey (or self completion questionnaire) to collect data are easy administration, convenient for the respondents since they can answer it when they want to and the absence of the interviewer effect i.e. when the characteristics of the interviewer affects the interviewee's answers (Bryman & Bell, 2003).

In the survey the respondent will have to consider a number of statements (see Appendix 5) regarding the company's planning process and its consequences by answering with "true", "false" or "no opinion/don't know". Answers to the survey were received from all investigated companies except from one. The result from the survey gives input and direction for the workshop discussions since the data contains information about what problems specific companies suffer from that can be related to the lack of a long-term planning process or if they don't have any of these problems. The survey also includes questions regarding the suppliers' FAI tool usage. The data collected from these questions is mainly used when answering RQ2 and RQ3.

Workshop

In order to get more input from the investigated companies regarding how they consider it possible to work with an S&OP process a workshop is conducted at Meridions' office. During this session, representatives from the investigated suppliers as well as representatives from some of their biggest customers are present. The aim is both to get a reference value regarding the maturity level of S&OP as well as getting input for how the different steps in the process can be performed, considering the context of the different suppliers. The basis for the workshop discussions are presented findings from previous work regarding RQ1 and the results from the survey containing information about planning problems the suppliers suffer from. At the workshop the group is divided into smaller groups and asked to discuss questions regarding appropriate process maturity level and how different steps in the S&OP process could be performed with consideration to their specific context. Afterwards the results are discussed in the whole group where some general conclusions are drawn. The data collected through the workshop is used as input to answer RQ3.

2.3.2 Secondary data

Literature review

The literature review is an important part to better understand the area studied and develop and structure the research questions (Bryman & Bell, 2007). For this study the literature review is vital in order to realize how an S&OP process should be structured and what parts it should consist of according to literature. Moreover is an S&OP maturity framework identified in order to be able to assess the suppliers' S&OP process maturity. From this gathered information a theoretical framework is developed to map collected primary data into. How this analysis is performed is stated in the Analysis chapter.

The literature review is performed throughout the whole study but the major part is conducted in the beginning of the project. The literature review is also a key input to get a deeper knowledge about the methods applied during the study. In the reference list, the literature used can be found.

Company documentation

When available, company documentation about the companies and their planning processes, is collected and studied in order to get a better understanding for their current planning processes. This documentation consists of for example company presentations, planning process structures, example of forecast sheets etc.

Delivery plans

For analyzes in the FAI Analyzer tool, real data, i.e. actual delivery plans sent from customers to the suppliers, is investigated. To have access to actual data increases the understanding of the reality in which the suppliers are operating as of today.

2.4 Reliability and validity

Reliability refers to the degree of credibility of the method, i.e. to what extent the same results are achieved if the investigation is repeated (Björklund & Paulsson, 2012). Bryman and Bell (2003) defines reliability as the consistency of a measure of a concept. For this study, the semi-structured interviews may result in different answers as well as different questioned asked depending on who is interviewed and the specific circumstances during that interview. If the study is repeated with another researcher, other follow up questions might be asked even though the interview is based on the same interview template. Another interviewee might also respond somewhat differently. Furthermore, the workshop is also very dependent on the people participating, even though their work tasks and responsibilities may be the same. These two methods may thereby be influencing the reliability of this study. However since many different methods are used the results somewhat overlaps. Hence, if another researcher would repeat this study, it is believed that the same result should be achieved more or less, especially if the researcher would interview the same persons during the same conditions as in this study.

Validity can be divided into internal validity and external validity where internal validity refers to the concern whether the conclusions drawn in the study can be trusted while external validity addresses the question whether the results can be transferred to other contexts (Bryman & Bell, 2007). Since the research design applied in this study is a multiple case study the time and resources spent on investigating every case is limited, which could decrease the internal validity. Nevertheless, in this study several different methods are applied (i.e. semi structured interviews, available company documentation, survey

and workshop) and this could be argued to increase the internal validity. After the initial interviews a summary of the interview result is discussed with the companies in order to get feedback on possible mistakes, clarifications and to fill possible information gaps. Furthermore, the participants at the workshop are able to give feedback on the findings obtained so far in the study. These two actions further ensure the internal validity. The external validity benefits from the fact that several cases are studied since this most likely make the conclusions and results more applicable for other companies.

3. Theoretical Framework

This chapter presents the theoretical framework, which is the basis for the whole study, created from the literature review. A deeper description of the sales and operations planning process and its main elements are followed by a section regarding S&OP maturity framework. Furthermore, the FAI analyzer tool is more thoroughly explained.

3.1 Sales and Operations Planning Objectives

The main goal with the process of S&OP planning is to achieve a balance between demand and supply while optimizing the company's efficiency and competitiveness (Dwyer, 2000; Bower, 2005; Jonsson & Mattsson, 2009). The supply relates to the current production capacity, e.g. machine-hours and number of employees, as well as current inventory of raw material, components and finished products. The demand consists of forecasts of future sales (Jonsson & Mattsson, 2009). Tuodrie and Borangiu (2011) breaks down the main goal further and lists the objectives of S&OP including; insurance that the plans are realistic and available, integration of manufacturing with the other activities of the business plan, elimination of hidden decisions, manage finished goods inventory in a better matter, among others. The aim of coordinating goals and plans in different departments is also highlighted by Jonsson and Mattsson (2009).

The S&OP process can also be described as one step in putting the overall company's strategic and tactical goals into actions, which may include goals regarding profitability or growth (Dwyer, 2000; Bower, 2005; Jonsson & Mattsson, 2009). The S&OP is then further concretized through more short term planning processes where the master production scheduling is followed by order planning before the actual procurement of material and the execution and the control in the production takes place (Jonsson & Mattsson, 2009). The relationship between the company's strategic goals and planning processes are illustrated in Figure 3. Decisions made in one level should always be within the framework of the decisions made at the level above (Jonsson & Mattsson, 2009).

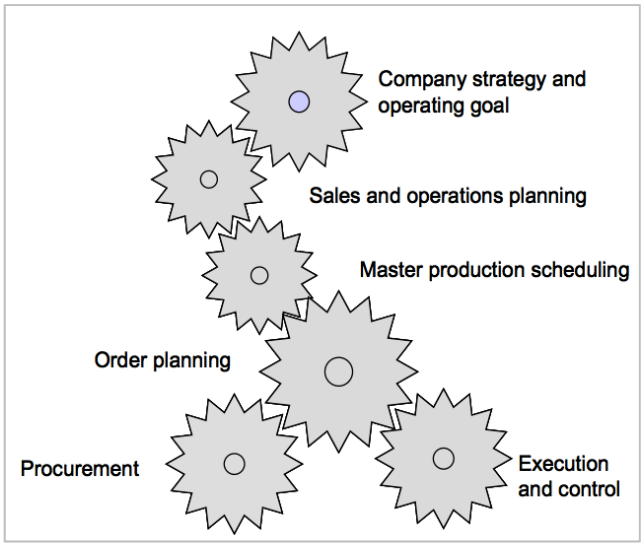

Figure 3. The relationship between different planning levels (Jonsson & Mattsson, 2009, p. 35)

The outputs from the S&OP process are the delivery plans and production plans. The delivery plan relates to the volumes that will be delivered to customers and is connected to the company's sales plans and sales budget. The production plans refers to the volumes that will be produced in each time period and relates to production volumes, material- and capacity planning. The difference between the production plan and

the delivery plan is the inventory, or order backlog in case of manufacturing to order, also referred to as the basic equation of logistics (Jonsson & Mattsson, 2009). In Figure 4 below the connections between the company strategy and the delivery and production plans are illustrated.

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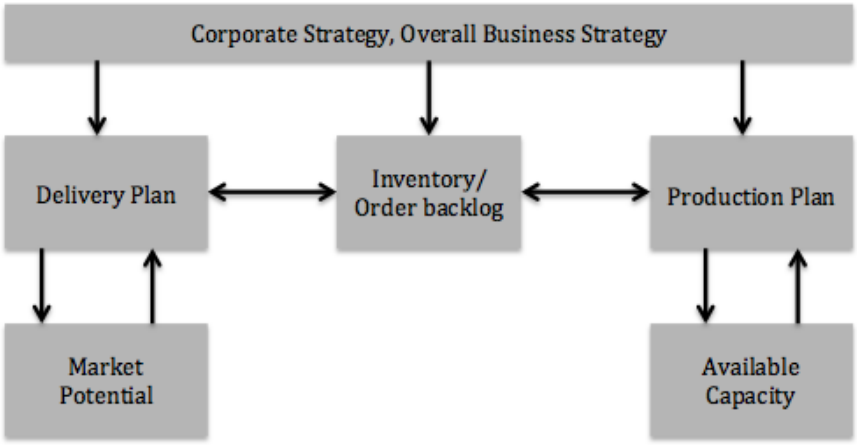


Figure 4. The relationship between business goals, delivery plans and production plans (After Jonsson & Mattsson, 2009, p. 163)

Companies that do not succeed to balance the demand and supply in a sufficient matter will experience consequences. In the case where the demand exceeds the supply the company risks to experience loss of sales, poorer delivery capacity and unnecessary costs related to overtime in production or express deliveries (Jonsson & Mattsson, 2009). On the other hand, where supply exceeds the demand consequences may include higher inventory levels and tied-up capital, higher unit production cost due to low utilization and lower revenues due to price discounts (Jonsson & Mattsson, 2009). The benefits of an effective S&OP process can consequently be many. Inventory levels, manufacturing downtime and on-time deliveries can be significantly improved by the introduction of an S&OP process (Lapide, 2004/2005; Wallace, 2010). Benefits regarding improvement plant efficiency and transportation costs may also appear, but not in as great extent. The author describes such benefits as hard benefits due to the fact that they can be quantified and measured. Soft benefits are more difficult to measure, and include among others; enhanced teamwork, embedded communication, greater control and better decisions made (Wallace, 2010).

3.2 Parameters for Sales and Operations Planning

In this section a number of parameters necessary for an efficient S&OP process is described. This includes the planning frequency, the planning object, the units of capacity as well as the length of the planning horizon.

3.2.1 Planning frequency

The S&OP process is usually carried out on a repetitive basis. How often it should be executed can however differ (Grimson & Pyke, 2007; Jonsson & Mattsson, 2009). Most literature recommends a monthly interval (Lapide, 2004; Bower, 2005; Sheldon, 2006), but according to Grimson and Pyke (2007), many companies are today increasing the frequency regarding their S&OP process. The reason for

a more frequent scheduling is, according to the authors, to have a more “event-driven” process where market dynamics and production environment are given greater consideration. Jonsson and Mattsson (2009) further emphasizes that the company context should influence how often the planning process is carried out, including parameters such as; lead times, market dynamics and frequency of new product launches.

3.2.2 Planning objects

Due to the fact that S&OP is focused on long-term planning of a company’s future procurement, production and sales, the level of detail of the units in production and delivery plans must hence be relatively low (Jonsson & Mattsson, 2009). It is therefore recommended to express the delivery and production volumes in product groups rather than individual products. Products belonging to the same group should have similar demand behavior, e.g. the variation of demand in seasons or business cycles should look the same since it is the whole groups aggregated demand that is forecasted. Furthermore, Jonsson and Mattsson (2009) stress the importance of products in the same group being as similar as possible regarding the production resources needed in manufacturing as well as the material required. The reason for this is that it is the aggregated demand of the product group that will be the basis for the capacity and material planning. Grimson and Pyke (2007) does mentions that some companies may use a more detailed level of their planning objects, e.g. single SKUs.

3.2.3 Units of capacity

When planning for the available capacity the level of detail should, for the same reasons as for the planning objects, be quite low (Jonsson & Mattsson, 2009). In some cases an entire workshop or a whole assembly line can be used as units for capacity planning. Capacity requirements are in those cases expressed as machine-hours, man-hours or number of employees. For companies with high similarity in their production, capacity can be expressed in production volume. Such production volumes could for example include units as euros, number or items, square meter or kilograms. In the case where it is not possible to use the same unit for production volume as for capacity requirements and capacity, volumes in production has to be translated into capacity requirements such as machine- or man-hours as described earlier (Jonsson & Mattsson, 2009).

3.2.4 Planning horizon

The planning horizon relates to how far into the future, plans should be made. According to Jonsson and Mattsson (2009) the planning horizon should at least cover one year ahead, due to the fact that it is strongly related to the budgeting. Furthermore, if there is a seasonal demand of the products it is also important to plan at least with one year’s horizon. However, how much further than one year into the future the planning should reach, is related to how far ahead planning is necessary to be able to adapt the capacity in production (Jonsson & Mattsson, 2009). These types of adaptations include investments in new equipment, employing or laying off production personnel or form new subcontractor relations. More than the production capacity, the length of the planning horizon must be adapted to the accumulated product lead-time (Jonsson & Mattsson, 2009). The accumulated product lead-time represents the time from ordering of raw material and other start-up material for manufacturing until the actual time when the product can be delivered. Furthermore, the time required for the development and introduction of new products can also influence the length of the planning horizon. The authors also mention that most

companies apply a planning horizon of between one and two years, but in some cases it may range to more than three years. Grimson and Pyke (2007) further stress the importance of the company's specific context when deciding on the planning horizon. For industries with long production lead time and high seasonality, such as apparel or automotive products, a longer planning horizon may be more suitable than for commodity items with a short production time (Grimson & Pyke, 2007).

3.3 The Sales and Operations Planning Process

Sales and Operations planning is performed in a stepwise process with different departments involved. How the S&OP process should be structured and what steps it should consist of is described by many authors (Lapide, 2004; Grimson & Pyke, 2007; Wallace & Stahl, 2008; Jonsson & Mattsson 2009). What the focus should be and what steps that should be included in the process may differ a bit among the authors. However, the steps recommended by Grimson and Pyke (2007) and Jonsson and Mattsson (2007) are considerable similar with the difference that Grimson and Pyke (2007) include measurement as a last step. In this section, five steps that should be included in the S&OP process, according to Jonsson and Mattsson (2009) and Grimson and Pyke (2007), are presented. These steps are also illustrated in Figure 5.

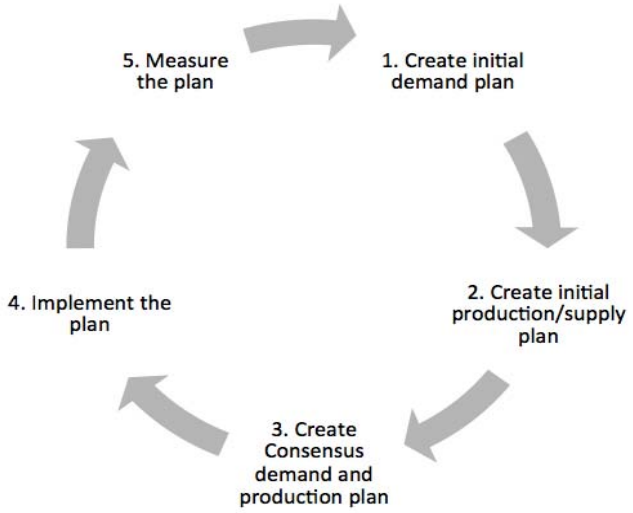


Figure 5. S&OP Process

3.3.1 Create initial demand plan

The first step towards the creation of a demand plan is to gather information in order to build an unconstrained forecast, not regarding what the company can produce but what the customers want to buy (Grimson & Pyke, 2007; Jonsson & Mattsson 2009). This forecast is typically performed by the sales or marketing department who gather both formal and informal information about what is expected to be sold to customers (Grimson & Pyke, 2007). Jonsson and Mattsson (2009) stress the importance of these estimations not being influenced by wishful thinking. The next step according to Jonsson and Mattsson (2009) is to, from the forecast, create a preliminary plan for future sales and delivery volumes. This plan, unlike the unconstrained forecast, refers to the volumes that the company wishes to sell and deliver per period and not the volumes demanded. These volumes are in most cases the same, but in some situations they may differ. Such situations includes when a product is being phased out and replaced by another

product, or when a company wishes to increase the demand with the help of marketing activities and price discounts. Uncertainties in demand can, according to Warren (2012), be handled by applying scenario analysis that can help the company understand the possible impacts of changes in demand and how to manage them in the best way. Scenario analysis permits the company to look into the future and thereby to act proactive (Warren, 2012). Within this step goals for inventory levels should also be established (Jonsson & Mattsson, 2009).

3.3.2 Create initial production/supply plan

In this step of the S&OP process the production department as well as those responsible for the supply of the start-up materials will create an initial production plan (Grimson & Pyke, 2007; Jonsson & Mattsson, 2009). The input for the production plan is the already created preliminary demand plan. The volumes that need to be manufactured, with regard to the desired inventory levels in order to meet the demand plan, will represent the preliminary production plan (Jonsson & Mattsson, 2009). However, in order to accept the production plan it is important to secure that the supply of start-up material as well as the production capacity is sufficient in order to manufacture the planned volumes. In the case where the supply of material and the capacity is large enough to carry out the delivery plan the preliminary capacity plan can be accepted (Jonsson & Mattsson, 2009). Otherwise, the plan must be adjusted by either increasing or decreasing the planned volumes or the production capacity,

3.3.3 Create consensus demand and production plan

The next step in the S&OP process is to create a final operating plan (Grimson & Pyke, 2007; Jonsson & Mattsson, 2009). This should be established in a reconciliation meeting where representatives from marketing, production, procurement and logistics are represented. Due to the fact that the delivery and production plans will have a large impact on the company's cash flow and tied-up capital, it is also important that representatives from the financial department attend the meeting (Jonsson & Mattsson, 2009). The aim of this meeting is to adapt the production plan, demand plan or goals for changing inventory levels in order to achieve a good balance between demand and supply so that the company's overall financial goals can be reached (Jonsson & Mattsson, 2009).

3.3.4 Implement the plan

The proposal for the demand and production plan is then reported to the company's top-management group, or an executive group, where any not yet resolved issues are discussed and the final plans are approved (Jonsson & Mattsson, 2009). When the plans are set it should be communicated to the involved departments (Grimson & Pyke, 2007; Jonsson & Mattsson, 2009). The marketing department should be aware of which quantities they should sell, in order to fulfill the demand plan. The production and material procurement departments are then obligated to make sure that the company can produce the volumes established in the plan.

3.3.5 Measure the plan

The final step is to measure the performance of the S&OP process, which is essential in order to be able to improve the process (Grimson & Pyke, 2007; Lapide, 2004). For the operations department, measurements including inventory on hand, obsolete inventory, stock outs and capacity utilization are commonly used. The sales team are mostly interested in measurements including top line sales and

forecast accuracy (Grimson & Pyke, 2007). According to Lapide (2004) the forecast accuracy is the most applied and important measurement for the S&OP process. Jonsson and Mattsson (2009) don't include the measurement as a separate step in their S&OP process. However, the authors do highlight the importance of doing continuous comparisons of the actual outcome and the planned volumes during the previous planning period for both the sales and production departments. This will show how well they managed to fulfill their obligations of selling the amount that they predicted and produce the volumes that they promised (Jonsson & Mattsson, 2009).

3.4 Sales and operations planning maturity frameworks

Gartner (2008) stresses that the S&OP process constantly must be managed and improved. However, today many companies' S&OP processes are far from ideal according to Lapide (2005). In order to progress towards a more ideal S&OP process the first thing that must be done is to assess the company's current S&OP process and then realize how to improve it. This can be achieved by using an S&OP maturity framework (Lapide, 2005). There are a number of S&OP maturity frameworks presented in literature with different focus areas included, and different numbers of maturity levels applied (Lapide, 2005; Grimson & Pyke, 2007; Gartner, 2008). Gartner (2008) presents a framework with five levels of S&OP maturity and four areas of focus; technology, performance management, organizational focus and process focus. Furthermore Lapide (2005) introduces a four-stage maturity framework with three focus areas; meetings, process and technology. Both of these frameworks attempt to offer a way for managers to assess their S&OP process and in the next step they present guidance on how to work in order to reach a higher level of maturity and a more effective S&OP process as a result (Lapide, 2005; Gartner, 2008). This is also true for Grimson and Pyke´s framework, i.e. that managers can use their framework to assess how effective their S&OP process is at current and how they can progress to make their process even more mature and effective (Grimson & Pyke, 2007).

3.4.1 Grimson and Pyke's framework

This section presents Grimson and Pyke's maturity framework, which is the basis for the process maturity analysis within this thesis. This framework is according to Jonsson[1] (2014) regarded as a well-established maturity framework for Sales and operations planning, which is one reason for applying this particular framework. The fact that Grimson and Pyke's framework is based on earlier literature regarding S&OP maturity and a number of company interviews further motivates this choice.

The purpose of Grimson and Pyke's framework, as already mentioned, is to help managers assess their current S&OP process and understand how to advance towards a more mature and effective process. This goes well in-line with the purpose of this thesis. The framework proposed by Grimson and Pyke (see Figure 6) has five maturity stages, where stage 1 represents a company having no S&OP process at all while a company in stage 5 is described as proactive when it comes to their S&OP process. The maturity framework further consists of five areas of focus namely; meetings and collaboration, organization, measurement, information technology and S&OP plan integration. The first three dimensions are primarily business processes while the last two are information processes (Grimson & Pyke, 2007). The five dimensions will be described further in the section below.

[1] Patrik Jonsson (Professor in Operations & Supply Chain Management at Chalmers University of Technology) 3rd September 2014.

	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 6. Grimson and Pyke's S&OP maturity framework (from Grimson & Pyke, 2007)

Meetings and Collaboration

The first dimension in the framework, meetings and collaboration, refers to the human component of the S&OP process and is used to assess its effectiveness according to Grimson and Pyke (2007). Lapide (2005) argues that routine meetings are a key aspect in an S&OP process. However, in stage 1, the lowest level of maturity, there are no planning meetings held and barely any collaboration between affected departments, i.e. sales and operations. The two affected departments work separately and only interact when a problem on either side arises and collaboration is inevitable. In stage 2 the sales and operation sides interact on a senior management level where meetings are held whereat managers from the two departments participates. Nevertheless the focus is rather on financial goals rather than on working towards integration of plans. There is little collaboration between employees from the two functions and there is a big risk that plans are far from optimal even though there is an interaction on senior management level. In stage 3 there are formal S&OP meetings held where both sales and operations personnel participates. On these meetings, that are held weekly or monthly, focus are on sharing information, integrating plans and resolve possible conflicts. Useful data from key suppliers and customers can be used as input at these meetings. Bower (2005) stresses the importance of having routinely meetings every month at least, the only exception when it can be reasonable to have less frequent meetings is when a company operates within a stable business environment and this is most often not the case (Bower, 2005). Stage 4 is a prolongation of stage 3 but on this level both customers and suppliers actively attends S&OP meetings and bring useful input to the table. In stage 5, the highest level of maturity, there are formal scheduled meetings where customers and suppliers participates, as in stage 4, but event driven meetings replacing scheduled ones can also be held in this stage in order to faster manage arisen shortages or such (Grimson & Pyke, 2007).

Organization

The organization dimension in the maturity framework aims at evaluating the corporate S&OP structure according to Grimson and Pyke (2007). Companies in stage 1 have no formal S&OP function, hardly even as a part of another job function. The awareness and knowledge of S&OP can be more or less infinite within a company in stage 1. Having no formal S&OP function also applies to stage 2, however there is usually someone within the company who is responsible for some of the S&OP tasks. In stage 3 the S&OP function is usually not a full time position but the responsibility of another job function such as for example the supply chain manager. Nor is there yet a formal S&OP team as in stage 4 where the company's executive level participates and all team members has clearly stated S&OP responsibilities in their job description. In stage 5 there is also a formal S&OP team with participation from executive level. The whole organization is in this stage aware of the S&OP function and respects it's outcome (Grimson & Pyke, 2007).

Measurements

The measurement dimension focuses on the evaluation of both the effectiveness of the S&OP process and the company's performance (Grimson & Pyke, 2007). Companies that are opened to use measurements as a starting point for continuous improvement will gain more from the their S&OP process than those who aren't according to Bower (2005). This since applying measurements is crucial for the process to be improved and successful (Bower, 2005; Lapide, 2004). Except for standard financial accounting systems there is a lack of measurements of operations and sales performance in stage 1. In stage 2 operations are driven foremost by sales orders and there is, most commonly, a monthly or quarterly evaluation made on how well operations meet the sales plans. Nevertheless nobody from the sales department is held responsible for poor sales forecasts, and aspects like capacity utilization is not considered when developing operations plans. When a company moves from stage 2 to stage 3 this however changes. In stage 3 sales managers are held accountable for their sales plans and these are evaluated by measuring the forecast accuracy and the operations function have a chance to adjust the operations plan after production capacity to make the production more efficient. S&OP effectiveness and new product introduction are two measurements that are introduced in stage 4. The measure of new product introduction include among other time-to-market, ramp-up time, development cost and so on. These measures are used since most other measures connected with operations apply only to products that have been produced for a longer time period. S&OP effectiveness is rarely measured in companies today according to the authors. Profitability is the one measure added in stage 5 to stage 4's measures. This is a common measure used in businesses today already but here, in relation to the S&OP process, it has a wider meaning than usually. The sales and operations managers are not only responsible for their own departments targets but are rather involved in and responsible for both departments reaching their targets where the final goal is to attain profit optimization (Grimson & Pyke, 2007).

Information technology

The evaluation of the information process is the focus of the information technology dimension (Grimson & Pyke, 2007). It is important to remember, stresses Lapide (2004/2005), that an IT system in itself is not very useful, a structured process is needed to gain any benefits from it. However, processes like S&OP often deals with a high level of complexity and in order to get the most out of the process a certain level of technology is most often needed (Lapide, 2004/2005). In stage 1 companies do not have any advanced software to support the S&OP process. It is common that a couple of spreadsheets exist in different departments but there is no sharing or comparison of information (Grimson & Pyke, 2007). The only

difference in stage 2 compared to stage 1 is that some consolidation of information is performed but the information systems used are still inferior. Revenue- or operations planning systems are utilized in stage 3 and the information is automated but not shared in an effective way. Companies in stage 4 applies revenue- and operations optimization systems to maximize profit, however plans are rather sub optimized than optimized jointly. In this stage an S&OP workbench (an automated tool) is applied in order to share operations and sales information automatically throughout the company in an effective way compared to stage 3. Stage 5 of information technology is today (read 2007) not possible to achieve. IT systems need to become more sophisticated to meet the goals set for a company in stage 5 for this dimension. The IT systems should be able to perform real-time optimization of sales and operations decisions in order for companies to faster react to market changes and by that not miss out on possibilities and be able to avoid threats (Grimson & Pyke, 2007).

S&OP plan integration

The overall objective with meetings and collaboration, organizational structure, measurements and information technology is S&OP plan integration. S&OP plan integration refers to how well a company develops sales- and operations plans and how well they are integrated. In stage 1 companies have no S&OP plan integration since they lack an S&OP process entirely. Operations are left to try their best in meeting orders as they come in, without any beforehand warning. There is no plan integration in stage 2 either, sales plans pushes the operations plans with no possibility to adjust sales plans after capacity utilization for example. In stage 3 more integration between sales- and operations plans exist, but sales are still mostly driving operations and not the opposite even though operations objectives are given some consideration in this stage. Moreover, sales forecast are being developed bottom-up and not top-down as in stage 1 and 2. These two factors results in more accurate plans to follow for operations. Companies in stage 4 have a higher level of plan integration. Sales- and operations plans are developed in collaboration between the two departments and the process is concurrent and not sequential as in previous stages. Further is greater consideration given to operations' constraints. As for the information technology dimension, stage 5 for the plan integration dimension is not reachable at current (read 2007), the IT systems have to become more refined before this is possible. However the vision of stage 5 is that companies will have an S&OP process where demand and supply are matched simultaneously in order to maximize profit and thereby reach the ultimate goal; profit optimization (Grimson & Pyke, 2007).

3.5 FAI Analyzer tool

The FAI Analyzer tool was introduced and shortly described in the corporate background. This section will give a deeper understanding of the tool itself and for the configuration parameters, the output variables as well as how the calculation works.

The FAI analyzer tool is a business intelligence tool that can help companies assess their forecast accuracy by measuring the KPI forecast accuracy index (FAI). It enablers a comparison between developed forecasts, at different time horizons, and the actual call offs from the customers. This analysis results in a visual image of how the forecasts change, as it gets closer to the actual order date. The comparison can be made at different time horizons, and thereby show how the forecasts are changing, as the order date gets closer. Furthermore, the analysis can be made at specific item level as well as for grouped articles or for whole customer groups.

3.5.1 Configuration Parameters

In order to perform the analysis, some input parameters must be established. These parameters include lag points, weighting factors as well as period horizon.

Lag points

The lag points should be set as the critical points in time for the supplier to obtain demand forecasts in order to preserve a good delivery performance. Often, these time intervals relates to a company's lead-time and/or logistics planning process. In other words, the lag points should be set to that point in time where it is crucial that the forecasts are accurate to secure the ability to produce the required volumes. Examples of such points in time are; final assembly, manufacturing and procurement decision. These time points could then function as three time lags in the FAI analyzer tool. In Figure 7 below the lag points are set to 2, 3 and 4 weeks in the settings.

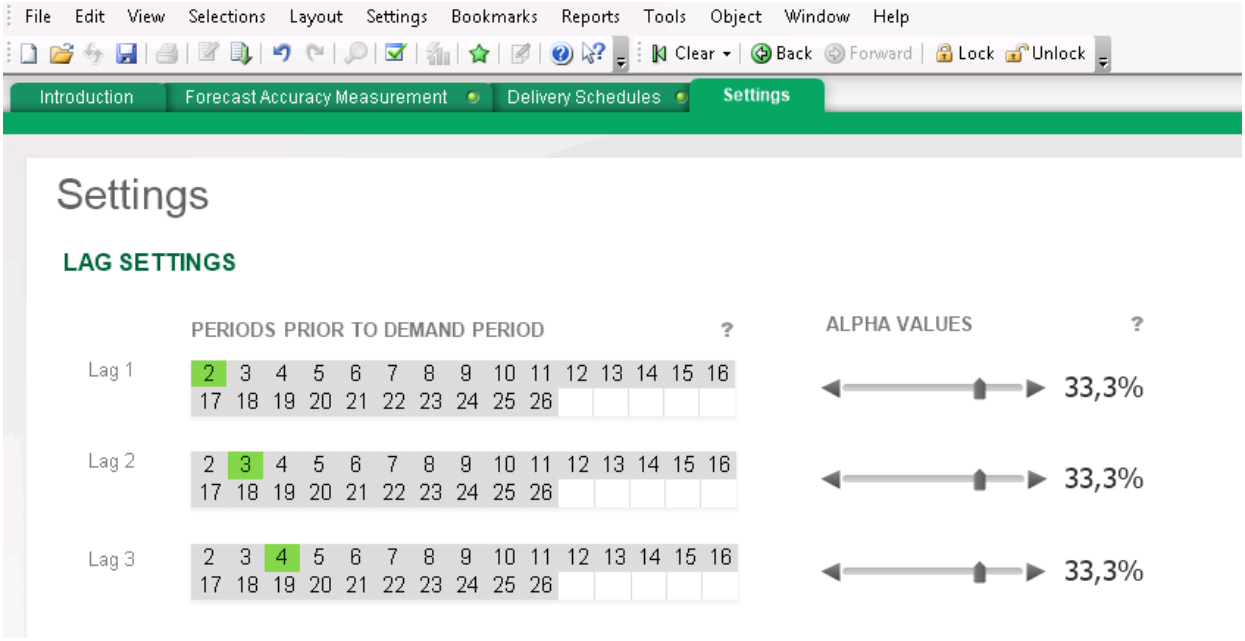


Figure 7. Settings in the FAI Analyzer tool

Weighting factors

The weighting factors are decided in order to describe the relative importance of the chosen lag points. In the case where all forecasts are as important, in order to maintain a high delivery performance, they should get the same weighting value, as in Figure 7 above where the alpha values represents the weighting factor for each lag point. When a certain forecast in a particular time lag are more important than another, this should get a higher value. However, the sum of the weighting factors must add up to 1.0.

Period Horizon

To ensure that the FAI value doesn't "overreact" when making small changes in the demand plan, e.g. the customer is moving their demand from Tuesday to Thursday in the same week, it is important to define a period horizon. How long this period should be is, as for the other parameters, deeply related to the company context. For some companies it may cause great disturbance if the demand is moved one week,

while others will not be affected unless it is moved up to one month. In the later case a longer period horizon is recommended in order to get a valid FAI. There are two different versions of the tool, one that applies a weekly planning period and one that applies a monthly planning period. When applying a monthly planning period, the aggregated forecasts during each month will be compared, while it is only a weekly aggregation when using the weekly planning period. The later version will hence give a more detailed visualization of the fluctuations, while the monthly planning period can be more useful for a more general analysis.

3.5.2 Measurements

The tool will give two different outputs, the Forecast Accuracy Index (FAI) as well as the Weighted Tracking Signal (WTS). FAI is a measurement of the forecast quality, in absolute value, where the actual volume demanded is compared with the forecasted volume in a specific time period. The WTS is a measure of whether the forecasts tend to be too high or too low compared to the actual volume demanded. The FAI value is calculated by determine the difference of a number of forecasted demands and a reference demand, which is defined as the last plan before the demand period. The time period between the forecasted demand and the reference demand is decided by the time lags in the configuration parameters. A simple calculation example can be found in Appendix 3.

3.5.3 FAI tool interface

The interface of the FAI tool can be seen in Figure 8 below. The graph illustrates how the FAI value varies over time. The lag points are set to 2, 4 and 6 weeks and the overall FAI is 50.9% and the WTS value 0.40. The user has a number of possible options when analyzing the data, namely Partner, Address, Item and Demand Period. Thus it is for example possible to analyze the forecast accuracy for a specific customer regarding a certain item for a chosen demand period. This high level of detail makes it possible to identify deviations patterns that could be discussed with concerned customer in order to find potential root-causes.

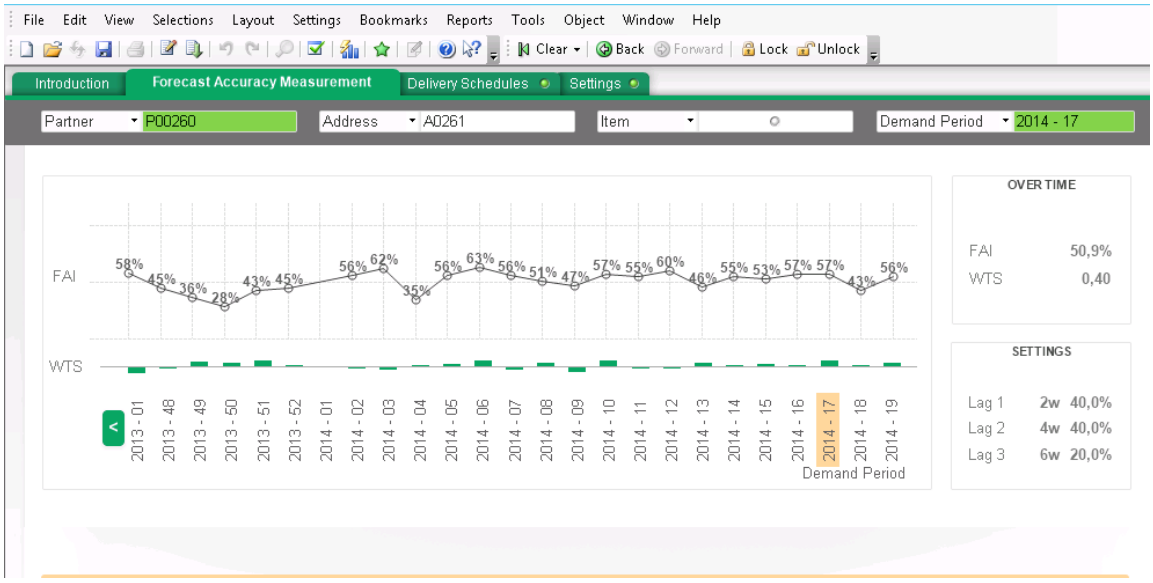


Figure 8. FAI Analyzer tool interface

When selecting a certain partner (customer), address and item for a certain demand period the reference demand and the forecasted demand for the selected time lags are illustrated as in Figure 9 below. Here, the actual volumes demanded (Ref.) are compared with the forecasts for that certain demand period in Lag1, Lag2 and Lag3.

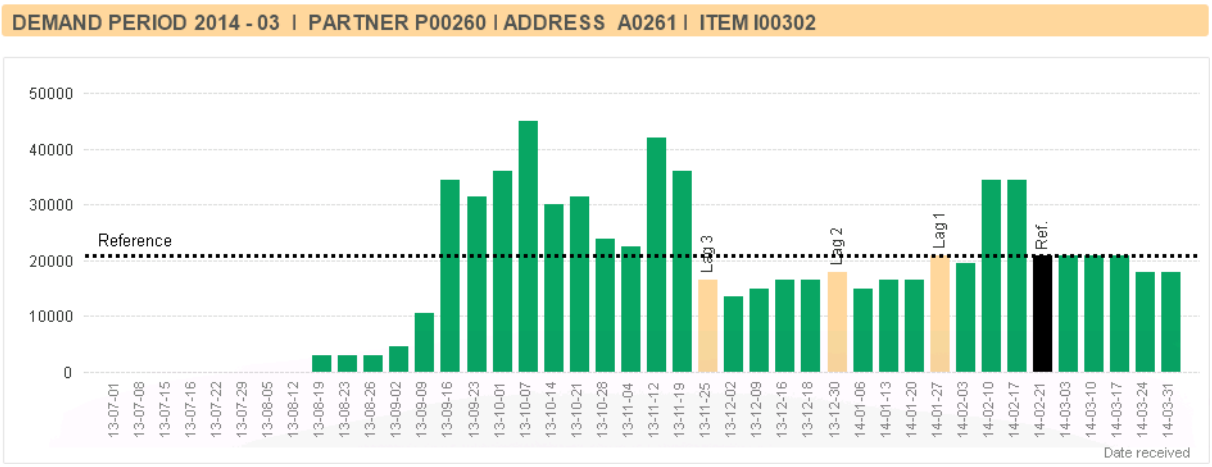


Figure 9. Demand fluctuations over time

4. Empirical Data

In this chapter the gathered data is presented, starting with the case descriptions where the investigated companies and their planning processes are described. Furthermore, data from the conducted survey as well as the results from the workshop are presented. Lastly, a presentation of how the investigated companies are working with the FAI Analyzer tool today is given.

4.1 Case Descriptions

The companies and their planning processes, based on the initial interviews, are presented in this section. The company context and the production process are briefly described followed by a presentation of how their planning processes are structured today.

4.1.1 Company A

Company A is a supplier of smaller steel components, foremost to the European automotive market. They offer a wide range of custom made products. In addition to these products that are developed and produced in-house, Company A also purchase additional products like plastic pieces and clips from suppliers that their customers demand. At present the company has around 6000 articles in their product portfolio. Company A has five market companies and six production sites spread around the world. Company A's customers are mostly big OEM's but also suppliers of different sizes.

Production process

The production has a functional layout where the product undergoes multiple operations before finished. The lead times in production are normally 4-6 weeks where queue in production makes up for most of that time. Company A applies the make-to-order principle since production is initiated by customer orders, however they produce batches so consequently there is an overproduction that goes to stock. Their in-house produced products are manufactured from scratch where steel is the raw material used. The lead-time from their suppliers is about 8-16 weeks.

Planning Process

Company A has a structured forecasting process that is executed 4 times a year with monthly planning buckets and a forecast horizon of 12 months. The forecast is mainly done by the market companies for each customer segment. The basis for the forecasts are the delivery plans from the customers, which is sufficient for most customers where Company A gets delivery plans for 8 to 12 months ahead. However, some customers are not as generous with sharing information, the horizon of the delivery plans can be as short as 2 months. Additional forecasting must then be created in order to cover the forecast horizon for all components. In the case where Company A is the only supplier of a certain component they might get information about how many end products the customer plans to sell and can thereby break down the need of that certain component. When all types of information from end customer is missing some degree of statistical sales history may be used, even though this is not desirable, according to the company, due to the high volatility in the automotive industry. When the forecast for each customer segment is created by respective market company, the forecasts are consolidated by the central logistic department that also may add some small adjustments and corrections related to possible mistakes or late changes in delivery

plans. The forecast is done in spreadsheets containing totally around 12500 lines. The central logistic department will then divide the forecast for the different production units. The final forecast is then shared with the production units as well as with the market companies. The total forecasting process extends over about three weeks and is done for single SKUs and delivery address. These are expressed as number of pieces, but also translated into weight (kg) and monetary terms (SEK).

Company A uses the created forecast for production planning, including capacity planning, batch size calculation, planning of tools, forecast of raw-material, etc. However, the production sites are obligated to produce what the market companies have decided and don't give any feedback to the market companies or logistics department regarding capacity constraints etc. Furthermore, the forecast is used as information to suppliers in order to secure incoming material. The main office also takes part of the forecast in order to make investments and strategic decisions.

Today Company A does apply common KPIs as delivery performance and some analysis with the FAI tool have been performed, but forecast accuracy is not evaluated on a regular basis.

4.1.2 Company B

Company B is a small manufacturer of primarily v-clamps and tank straps, and their biggest markets are Sweden and Germany. The company has two production sites, one in Sweden and one in Lithuania where the bigger part of the production takes place. However, the Swedish site, where also the headquarter is located, does manage the all operational activities for the Lithuanian site The company have about 560 products and all products produced in-house are custom made, developed and tested by Company B. In addition to the products produced in-house, a supplement product assortment is purchased and traded. The company has several and big OEM, but also smaller suppliers, as customers.

Production process

The production process has a functional layout where a product normally passes 5-6 operations before finished. The production lead times are generally five working days, exceptions are when products needs to undergo operations that are not available in-house, then the lead times can be up to 1.5 months. They apply make-to-stock and stock levels initiate the production. The main raw material used is steel and lead times from suppliers are usually about two weeks.

Planning process

Company B uses delivery plans, sent from their customers, with a horizon of usually one year as input to their planning work. The delivery plans are directly transferred into their ERP system without any alterations made and the plans are considered to be relatively accurate. However, for a small portion of Company B's products where they don't receive any delivery plans from their customers a simple manual forecast is created. For new projects, the sales department gets information from the customer regarding future demand.

When new projects are under negotiation, the sales department discuss with the production department if there is available capacity to take on the new project. This is an important aspect when it comes to increasing capacity with new equipment, which is a long-term process that also involves top-management. For the ongoing work however, production is mostly driven by plans from the ERP system.

As mentioned above, the sales and production department has a good communication during the project meetings, which are held every week. Furthermore, every other week the top-management is gathered where managers from production, purchasing, marketing, among others are included. During these meetings it is easy to discuss any imbalances or problems between the sales, production and supply plans. As of today, Company B measures delivery performance and other common KPIs but forecast accuracy is not measured on a regular basis.

4.1.3 Company C

Company C is a supplier of air and fluid tube systems for trucks, cars and busses. The company has two sites, one for the main production to the car division and one that supplies to the heavy vehicles division, where the latter is the focus for this thesis. At this site, Company C manufactures about 400 products that are customer specific. The company delivers to a few but big OEMs.

Production process

The main ingoing material is cut tubes that are end-formed, bent and welded or brazed to the desired properties in-house. A large portion of the products then undergoes a surface treatment at an external surface treatment company. The production is structured in a functional layout with bending machines as one function and welding operations as another. However, some products are manufactured in automated cells. It takes about two to three days to manufacture one product. In the case where the product needs surface treatment about five extra days are required. This long lead-time is mainly the reason for why Company C manufactures to stock.

Planning process

Company C uses their customers' delivery plans as the only input to their planning, and do not develop any demand forecasts on their own. The delivery plans usually has a time horizon of one year, on a SKU level, and are directly transferred into their ERP system, from where the production plans are created.

Twice a month a meeting with participants from both production and logistics is held, where capacity planning regarding 4-10 weeks ahead is addressed. Furthermore, in the case of new products, a top-management meeting is held in order to make decisions regarding investments of new capacity. As of today, Company C have started to perform some measuring of their forecast accuracy by using the FAI tool to evaluate incoming delivery plans but not to any significant extent as of yet.

4.1.4 Company D

Company D is a supplier of products for protecting, marking, fasten and fixing cables and their connecting components. They are located in 34 countries all over the world with 12 production sites and about 3600 employees. Their products are primarily low cost standardized products where about 87% of the products are produced in-house. Customers of Company D range from smaller distributors to big OEM's.

Production process

Company D's products are mainly injection molded plastic articles for which the production lead times are short and the products do only pass through this single operation. The lead times from Company D's

production sites to the distribution site in Sweden range from 2-6 weeks depending on production site. Make-to-stock is the most common approach but end-of-line production is also applied at one production site.

Planning process
Once a month Company D updates its' forecast for the next coming months. The forecast is based on delivery plans from their automotive OEM customers, which stretches over the 18 next coming months. However, this only covers a small part of Company D's total product assortment, and for products where they don't receive any delivery plans Company D uses quantitative forecasting processes where sales history is the main input. Furthermore, during a monthly meeting with one of their OEM customer, some qualitative input to the forecast may be given as well. The forecast is always made at SKU level.

The production sites doesn't take part of the developed forecasts and only get to see the incoming orders from the market companies meaning that the production only make their plans as the orders are received in a short-term horizon. However, the market companies do have a continuous communication with the production sites in order to secure the sent orders and to solve any upcoming issues.

Company D measures their forecast accuracy on a repetitive basis. Furthermore, the company is continuously using the FAI analyzer tool in order to measure the quality of the delivery plans sent from the OEM customers.

4.1.5 Company E

Company E is a specialist within exhaust technology that supplies mainly to two big truck manufacturers. To each of them, a number of four respectively eight customer specific products are produced, with a number of variants for every product. Furthermore, Company E produces about 200 other SKUs. The end products are placed in the high-value section, mostly due to the high cost of certain ingoing material.

Production process
Company E has a highly automated production site where most products goes through an automated production line, divided in a high- and low volume flow. For their end products Company E applies a kanban system, where the finished inventory represents a certain safety time. Due to the fact that the company have been involved in the product development of the most complex components, most production steps are made in-house in order to secure the patent owned by the customers.

Planning process
Company E receives delivery plans from their customers, directly into their ERP system, twice every week. These delivery plans reaches over a horizon of 12 months and represents the only input to their demand plan. All plans are made for single SKUs and specified at a daily basis. The delivery plans are then used as input for the production plans.

Every Tuesday the logistics department creates the production plans and checks whether there is enough capacity to be able to produce the volumes in the delivery plans. The next morning a meeting with logistics, production, maintenance and HR is held, where first the next coming four weeks are discussed followed by the next quarter and lastly the next coming 12 months. In cases where there is a discussion

regarding changing shift forms representatives from the union is invited to the meeting. Furthermore, the sales department is represented when big changes in the customer's delivery plans have been discovered, to confirm the credibility of these changes. In cases where there have been quality issues the quality department is also involved in the meeting. This meeting is followed by a more operative meeting at Wednesday afternoon, where decisions from the morning meeting are executed, regarding change in shift forms etc.

At current, Company E measures planned volumes with actual outcome for rolling 12 months. Some analysis of the delivery plans with the FAI tool is also made at a repetitive basis.

4.1.6 Company F

Company F is a family owned company that produces steel tubes and yearly handles more than 100.000 tons of tubes. Their head office and central warehouse is in Sweden, and branch offices can be found all across Scandinavia as well as in The Baltic states. They divide their market into six different product market segments (PMS) where automotive represents 25% of sales and construction 35%. Company F has thousands of different products, both standardized and custom made, that are divided into 14 product families. They have around 1700 customers who are mostly suppliers within different tiers, but also different manufacturers and distributors.

Production process

The production has a cell layout where processes like cutting, cleaning, tumbling and sandblasting are included. Surface treatment, bending of tubes, milling and turning are examples of processes that are out sourced. The main ingoing material is steel-tubes in different sizes. Company F both applies make-to-stock and make-to-order, depending on the product. Lead times from some suppliers are up to 18 month, which in combination with poor delivery performance results in no option but having a fairly large safety stock in relation to their turnover.

Planning process

Company F has a variety of customers where some send delivery plans for one year ahead (automotive customers) and others send orders without warning. In the cases where delivery plans are received they are imported directly into their ERP system without any manual adjustments made. When delivery plans are not received forecasts are developed. This is performed by the ERP system where the last six months are roughly mirrored for the next coming twelve months. The forecast is updated every week and is made at SKU level with a weekly planning bucket. A budget forecast is developed every year and is based on indications from the customers.

The order stock is constantly updated by sales that ensure that needed material is available in stock and then the production planners ensure needed capacity. The system delivers the production schedules. There is daily communication between the production planners and production that reviews the capacity situation. Twice a week the capacity situation is evaluated for the next 20 days. Capacity checks for a longer horizon are made to some degree, especially due to the long lead-time from suppliers, regarding the stainless steel in particular.

Sales and the purchase department have meetings twice a week, discussing issues concerning the very near future. The same applies to the production planners and production. Communication between production and sales departments occurs mainly when problems arise. One reasons for this silo culture is that production is located at a different site than sales and purchase. Company F measures delivery performance and other common KPIs but not forecast accuracy or other measures directly connected to the planning process.

4.1.7 Company G

Company G is a global manufacturer of high technology components, operating all over the world. The company provides customers with their products within all major industries, both manufacturers and aftermarket customers.

Production process

For the product segment that represents the greatest share of the total production, every production site is built with a channel structure. Each channel is thereby dedicated to a certain product assortment. Each production facility manufactures the assortment to cover its geographical market, thus many production sites produces the same products. For some products a make-to-order strategy is applied, while more standardized products are made-to-stock. Due to the good information shared from big OEMs regarding their future demand of certain products, these are segmented as planned items.

Planning process

Company G has a formalized S&OP process where the first step is the forecasting, which is performed and updated once every month with a time horizon of 24 months. The forecast is initially constructed by a forecasting manager, each responsible for one sales unit (20 sales unit is involved within the S&OP process). This forecast is based on a statistical analysis of sales history. The next step involves 300 collaborators who adapt the forecast based on their customer knowledge. Before the forecast is released a reconciliation between the forecast manager and the collaborator is made in order to accept and agree on the final plan. Some aggregation of the planning objects is done in those cases where a large variance of products is sold to small customers. However, it is always possible to disaggregate the demand to SKU level.

Furthermore, once every quarter a macro-analysis is made in order to get indications on the economic climate and is a good complement to the created forecast. This is more of a top-down process, compared to the forecast development, and is used as an input to fine-tune the forecast.

The production sites are presented with the developed forecasts and evaluates whether they will be able to meet the forecasted demand taking into consideration capacity and other constraints. Suppliers are also asked to investigate if they are able to meet Company G’s future demand. If there are any problems in meeting forecasted demand this will be discussed at the review meetings held every month where plans are accepted and possible issues are raised. Participants in these meetings depend on the S&OP responsible in the business organization who is the one responsible for inviting people to this meeting and the output of the meeting. If more severe issues than what can be resolved at these review meetings arise, a so-called escalation will be carried out where the problem is elevated to a higher level within the company. During the escalation meeting any not yet resolved issues are discussed and actions are

planned. This may include decisions regarding capacity increase orallocation of orders between production sites. When plans are made and accepted these represents the framework and constraints for how more shortsighted plans can be made. The plans are shared with the help of a specific software to the involved parties.

Company G measures forecast accuracy on a regular basis where both the statistical forecast and the forecast adjusted by the collaborator are evaluated. The reference is the actual volumes sold, and not the actual demand, which in some cases, e.g. when not being able to deliver due to production problems, may be misleading. Furthermore, measurements regarding productivity and inventories are evaluated for each production site. Company G also applies PPI (Process Performance Indicators) on their S&OP process, in order to secure that everyone follows the stated process. This is controlled through audits at the different entities.

4.2 FAI Analyzer tool usage

According to the interviews and the survey result the companies have started to use the FAI tool for both internal and external purposes. The tool is mainly used to measure forecast accuracy of delivery plans, but to a small extent at present. An example of measured forecast accuracy of delivery plans for the short term, with lag points (see chapter 3.5.1) set to 2, 4, 6 weeks, and the long term, with lag points set to 8, 15, 20 weeks, from one of the investigated companies can be seen in Figure 10 and Figure 11. The measurement is done on four customers' delivery plans. For the short term horizon the FAI value is around 60% and for the long term horizon about 30%.

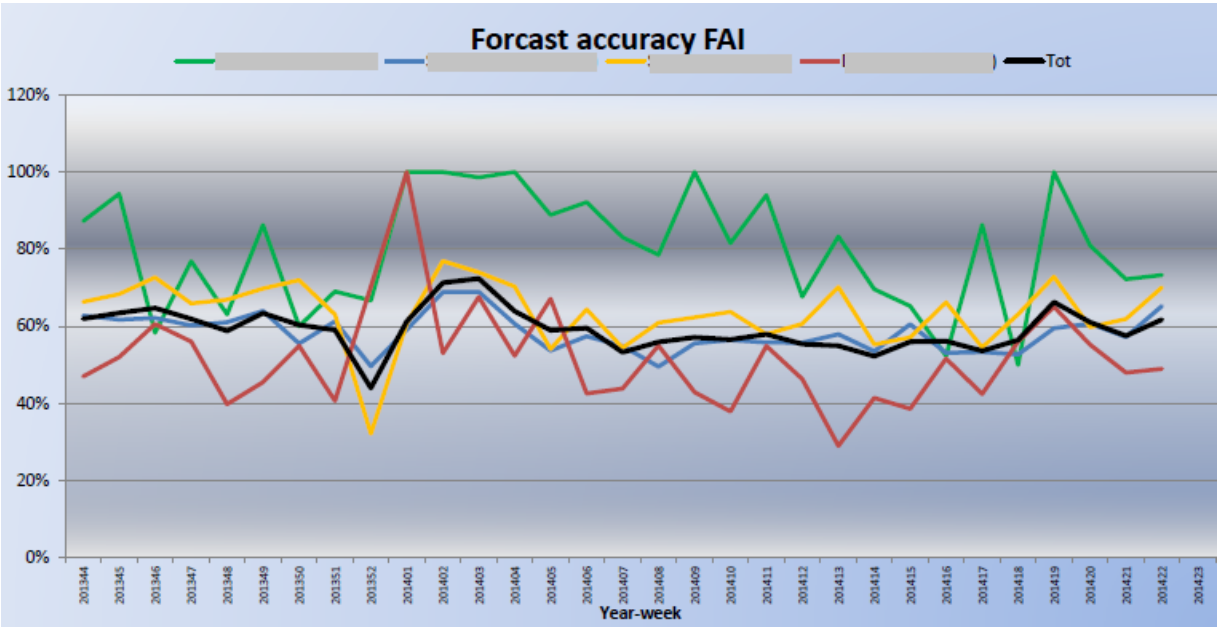


Figure 10. Forecast Accuracy Index for lag points 2,4 and 6 weeks for 4 different customers

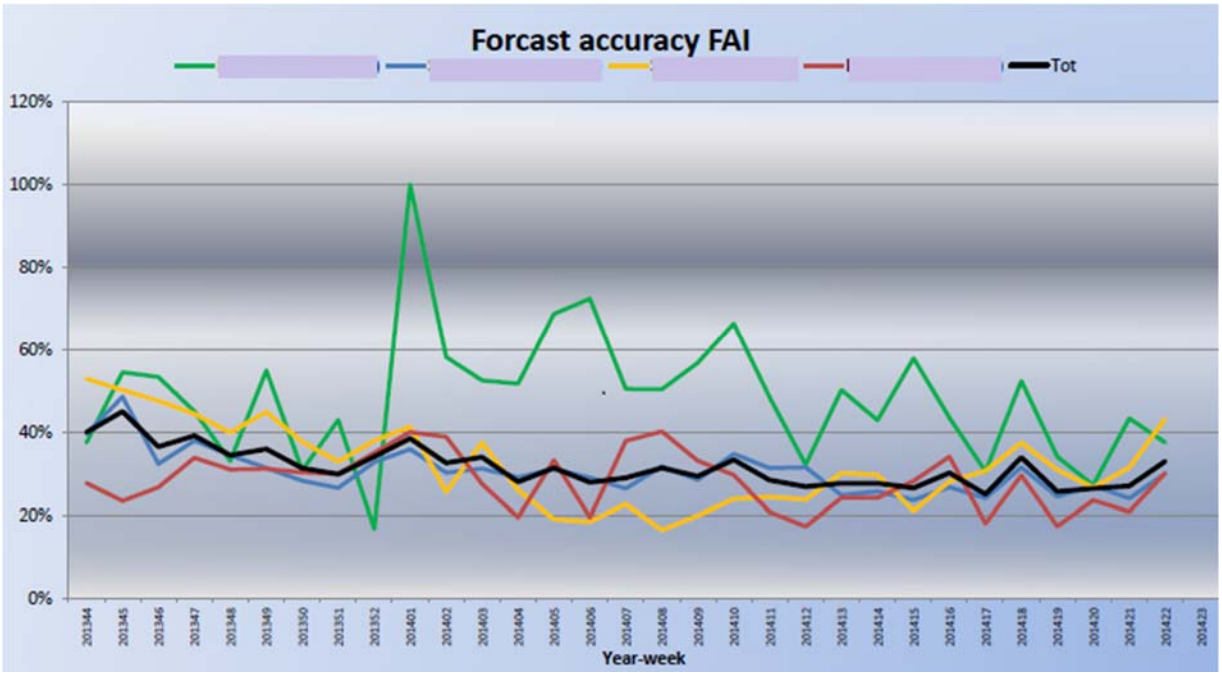


Figure 11. Forecast Accuracy Index for lag points 8, 15 and 20 weeks for 4 different customers

Companies are mainly analyzing delivery plans sent from customer in order to identify deviating patterns. A dialogue have in some cases been initiated with concerned customer with good results, i.e. the root causes of the deviations have been identified, analyzed and resolved with more accurate delivery plans as a result. The tool is also used, at some companies, in order to optimize inventory levels based on patterns discovered in the delivery plans. For the purposes stated above the weekly application of the FAI tool is applied on a short-term horizon. The monthly application is used very limited by the suppliers at present but some have applied it to get a more overall picture. As of today, few of the investigated companies are using the FAI Analyzer tool on a regular basis. Analyzes are mainly performed when obvious problems has arisen. Time and resource shortages are identified as reasons for the discontinuous measurements. At some companies, the tool hasn't been introduced to the right positions, i.e. the persons who should be responsible for such evaluation, as of yet, which also is related to lack of time and resources.

4.3 Survey

The survey was conducted to get a basis and direction for the workshop discussions and was sent out in advance and answered by most companies attending the workshop. The aim with the survey was to identify what consequences and problems related to the planning activities the companies are suffering of and further to use this input as a motivation for the need of an S&OP process.

The results from the survey (see Figure 12 and Figure 13) show that many companies experience problems related to their planning processes. Of the respondents 83% see difficulties with developing forecasts with a horizon of 1-2 years and on the other hand are delivery plans sent from customers not considered accurate enough to base decision on regarding capacity and supply according to 50% of the respondents. Furthermore most respondents have problems with capacity availability i.e. machinery and staff due to short planning horizons and material shortage due to long lead times is also recognized as a

problem. An interesting observation is that Company G, that has the most developed S&OP process, did not suffer from these problems to the same degree as the other investigated companies.

To have meetings and continuously communication between different departments affected by the planning activities is also viewed as important, however some answered that this communication occurs first when a problem has arisen. To measure forecast accuracy is evaluated by most respondents (83%) as important but most doesn't perform this measure at the moment according to the survey result. The survey and total results can be seen in Appendix 5 and Appendix 6.

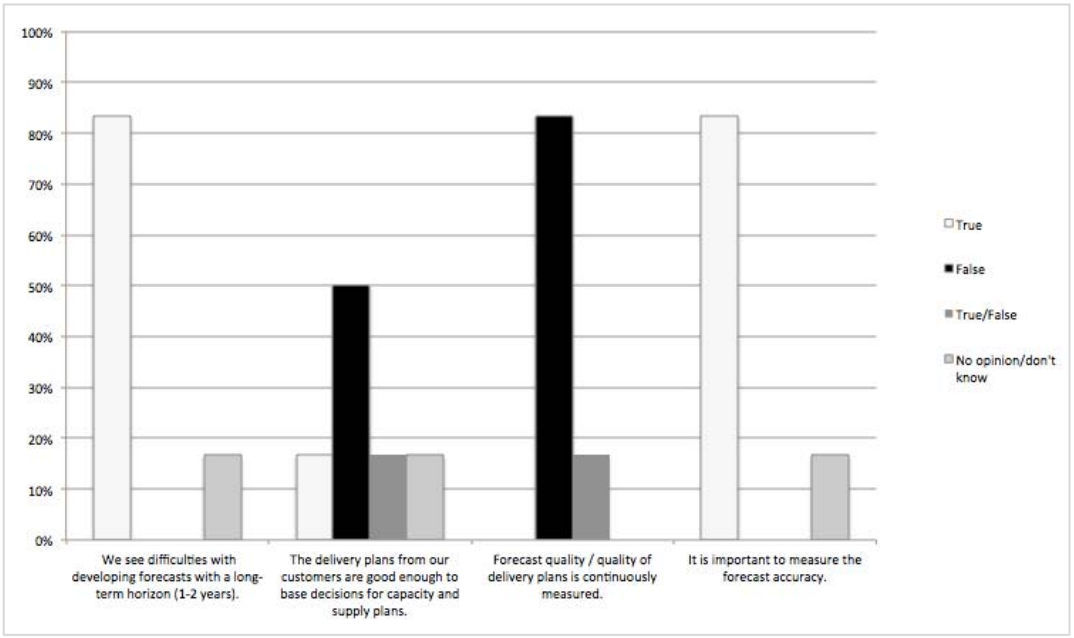


Figure 12. Survey results

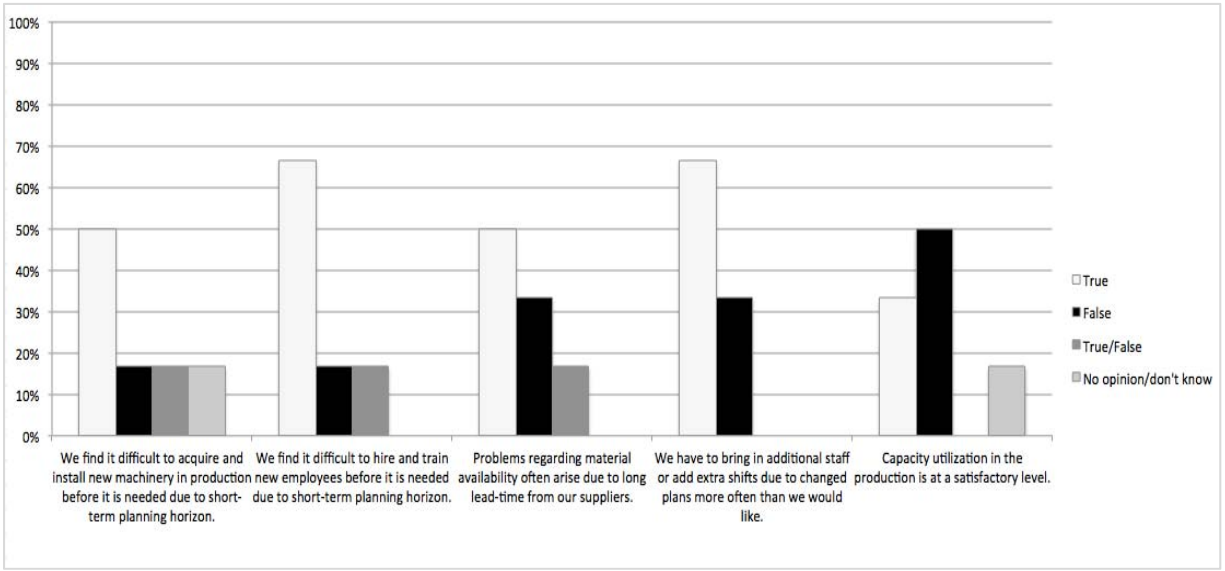


Figure 13. Survey results

4.4 Workshop outcome

In this section, the output of the discussions during the workshop is presented. Unfortunately all companies from the study were not able to participate, the companies that did were Company C, E, F and G. However the result from the workshop is complemented with information gathered from the companies not attending the workshop in order to get an as comprehensive picture as possible. This was done through a follow-up discussion with concerned companies. The workshop was divided into two parts, where the first part focuses on the maturity level of the S&OP process, and the second part focuses on the process structure.

Part 1 - S&OP maturity

The first part of the workshop was to identify the dimension with the greatest potential and what an appropriate maturity level could be at present for the different companies. The result can be seen in Figure 14, where also the result from the companies not attending the workshop is presented. Participants from Company G were involved in two group discussions and therefore two different answers were given. The first one was to reach Sstage 5 on the measurement dimension in order to actively connect the S&OP process with company profitability to more effectively drive improvements. The second one was to reach stage 4 on the S&OP plan integration dimension to improve integration and sense of ownership of the process and in this way increase the lowest level at concerned sites. Both Company C and E concluded that reaching stage 3 on the meetings and collaboration dimension has the most potential for their specific context at present. This is motivated by the great need of communication to get the process working and that this will also improve integration in a good way. Company F identified reaching stage 3 on the measurement dimension as most crucial for them at present, motivated by the need to measure in order to improve. For the companies that didn't attend the workshop Company A identified reaching stage 3 on both the meetings and collaboration and the IT dimension as the most crucial ones due to limited communication between departments at present and a need for a software to centralize data and manage the process more efficient. Company B considers reaching stage 2 on the organizational dimension as most important since there is no one responsible today. Company D regards reaching stage 3 on the meetings and collaboration dimension as most essential at present since the communication today is reactive rather than proactive between functions.

	Stage 1 No S&OP Process	Stage 2 Reactive	Stage 3 Standard	Stage 4 Advanced	Stage 5 Proactive
Meetings & Collaboration	• Silo culture • No meetings • No collaboration	• Discussed at top-management • Focus on financial goals	• Formalized S&OP meetings with participation from relevant dep.	• Supplier & customer participation	• Event driven meetings • Real-time access to external data
Organization	• No S&OP organization	• No formal S&OP function • Components of S&OP in other functions	• S&OP function is part of other position: Product manager, supply chain manager	• Formal S&OP team • Executive participation	• S&OP is understood throughout the whole organization
Measurements	• No measurements	• Measure how well operations meets the sales plan	• Forecast accuracy	• S&OP effectiveness	• Company profitability linked to S&OP
Information Technology	• Individual managers keep own spreadsheets • No consolidation of information	• Many spreadsheets • Manually consolidated	• Centralized information • S&OP software	• S&OP software linked to ERP	• Integrated S&OP optimization software
S&OP Plan Integration	• No formal planning • Operation attempts to meet incoming orders	• Sales plan drives operations • Capacity utilization dynamics ignored	• Some plan integration • Sequential process	• Plans highly integrated • Concurrent & collaborative process • Constraints applied in both directions	• Process focuses on profit optimization for whole company

Figure 14. Workshop result, S&OP maturity

Part 2 - S&OP Process structure

During the second part of the workshop, two questions regarding the S&OP process structure were discussed. In Table 1 and Table 2 the output of the workshop discussions is summarized.

Table 1. Workshop result, Demand plan

How can we create a reliable demand plan?

Input	Output	Parameters
Delivery plans • Ensure horizon for all customer/products Market analysis • However maybe not possible for smaller companies Historical data • However risky to look backwards Other customer information: • Customer long term forecast • Specific intelligence on customers/products • New product launches	Product type is of critical importance • Less no. of items/high volume - SKU level • More no. of items/low volume - Product line or aggregated Aggregated on relevant capacity dimension • Products through a certain line/cell • Products with the same inbound material What-if scenarios • Highest/lowest possible outcome, how much could the demand vary	Horizon • Identify lead time parameters that impact operational horizon if more than 12 months • Otherwise 12 months Object • Identify “product groups” Frequency • Monthly

Table 2. Workshop result, Production/Supply plan

How can we in a better way consider production/supply capacity constraints and possibilities?

Input	What to consider?	How to optimize capacity?
Created demand plan Own capacity data • Get understanding about your own gaps, doesn't matter how accurate the demand plan is if you haven't got control of your own production	Critical decision points • Identify lead-time for existing in-house capacity increase or decrease (machinery and manning) • Identify procurement lead-time Simulate the different demand scenarios • Can the what-if scenarios be met with available capacity	Transparency • What possibilities/limitations do we have System support • Depends on size and complexity of the company

5. Analysis

In this chapter, the empirical data is analyzed against the theoretical framework and the three pre-stated research questions are answered. Thus this chapter contains firstly a mapping of the companies current S&OP processes and identification of gaps compared to the theoretical framework followed by suggestions on how the FAI analyzer tool can be used in the S&OP process and lastly guidelines for how to design and perform an S&OP process for the given context is presented.

5.1 Mapping of current planning processes and S&OP maturity level

In this section the suppliers' planning processes are mapped into the S&OP process structure, which is defined in the theoretical framework. Furthermore is the identified maturity level, for each supplier, mapped into the maturity framework of Grimson and Pyke, which is also described in the theoretical framework.

5.1.1 Company A

In this section Company A's planning process is mapped into the S&OP process and the maturity framework.

S&OP process structure

Even though Company A doesn't have a defined S&OP process, some of the steps included in the process exist. Figure 15 below gives a clear picture of which steps Company A practices today. The black-marked steps correspond to the ones they have today, and the unmarked are steps that are missing.

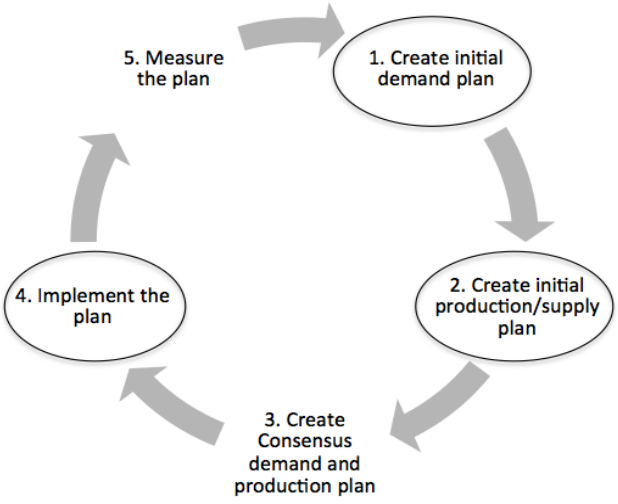


Figure 15. Company A's current S&OP process

1. Create initial demand/delivery plan
Company A has a structured forecasting process with a long-term horizon that is performed every quarter, which represents the first step of an S&OP process.

2. Create initial production/supply plan
The created forecast is used as input for long-term planning regarding both production and supply of material. Production and supply capacity is secured locally at each production unit. This step is thereby regarded as fully existing.

3. Create consensus delivery and production plan
As of today, there is no reconciliation meeting between market and production units where a consensus plan is created. The production units are, as mentioned earlier, obligated to produce the volume requested. However, Company A does have plans of introducing meetings every quarter, in connection with the forecast process, where employees from the different units shall participate.

4. Implement the plan
Company A uses the created forecast for production planning, including capacity planning, batch size calculation, planning of tools, forecast of raw-material, etc. It is further used as information to suppliers in order to secure incoming material. The main office also takes part of the forecast in order to make investments and strategy decisions.

5. Measure the plan
Company A doesn't apply any metrics that can be connected to the planning process and the forecast quality is not measured, which is why this step is considered as missing.

S&OP maturity
In this section the level of maturity regarding Company A´s S&OP process is mapped into Grimson and Pyke's framework.

Meetings & Collaboration
There is some collaboration between the sales and logistics department through the forecasting work, where information concerning the forecast is shared. Further does also top management take part of the developed forecast. However there are no formal S&OP meetings and the maturity level of this dimension is therefore set to the second stage.

Organization
The logistics manager and his subordinated are the forecast process owners. They perform some S&OP tasks, however no formal S&OP organization is stated and the concept is not established within the company thus this puts Company A in stage 2.

Measurements
Company A does mostly just monetary measurements that aren't directly connected to the planning process. However, sales compare their sales forecasts to the actual sales in some sense, consequently the maturity level is considered to be at stage 2.

Information technology
For the forecasting process, Company A uses spreadsheets that are manually disaggregated and consolidated by the logistics department. Therefore, Company A reaches the second stage of maturity within this dimension.

S&OP plan Integration
Sales forecasts drive operation with little or no consideration to production constraints or possibilities; however developing sales forecast is a bottom-up process so the maturity level is considered to be stage 2.

Implications
From the analysis of Company A's current S&OP process it is clear that step 1, 2 and 4 are fully existing, while step 3 and 5 are missing. Due to the fact that Company A receive different horizons of the delivery plans from their customers it is necessary to have a forecasting process to cover the total planning horizon. According to the company, these differences are connected to where their customers are based, e.g. Nordic based customers tend to send longer plans than customers based in more southern parts of Europe. Even though Company A has a well-developed forecast process, which is quite time consuming and involves many different persons, they don't measure the quality of the work they preform. Hence, it is difficult to state if the forecasting process really pays off. Furthermore, the company uses spreadsheets for this process, and updates about 12000 lines, with a total of 85000 cells each time. According to themselves, this is an unsustainable approach since such a huge document easily gives room for human mistakes. Company A has, due to this, raised discussions about investments in some sort of software connected to the demand planning. The company's geographical spread is also an aspect to consider, since it complicates the integration between the different departments, especially the market companies and production sites. As of today, communication between these two departments occur first when problems has arisen. Company A does thereby recognize the need of more cross-functional collaboration themselves in order to increase the plan integration. Difficulties in hiring and training new personnel before the increased capacity is needed are also mentioned as a problem for Company A.

5.1.2 Company B
In this section Company B's S&OP process is evaluated. Even though Company B doesn't have a defined S&OP process, some of the steps included in the process exist to some degree. Further is the company´s level of maturity regarding their S&OP process mapped into the framework.

S&OP process structure
Figure 16 below gives a clear picture of which steps Company B practice today. The dotted steps represents steps that Company B practice to some degree, and the unmarked are steps that are missing.

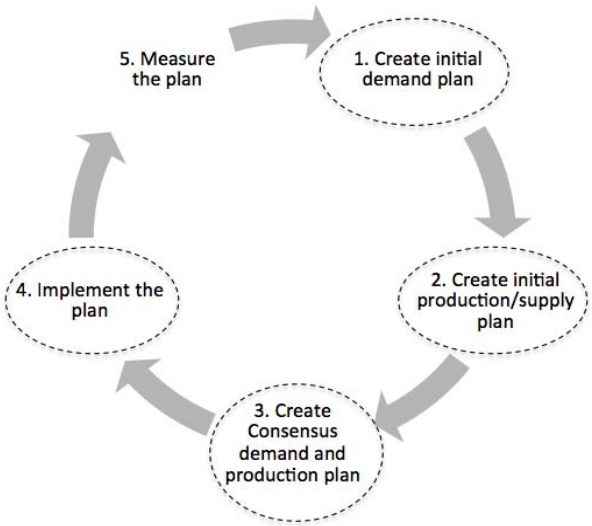


Figure 16. Company B's current S&OP process

1. Create initial demand/delivery plan

Company B import received delivery plans from customer into their ERP system. For new projects, the sales department gets information from the customer regarding future demand that is taken into consideration. Furthermore, for a small portion of Company B's products where they don't receive any delivery plans from the customers a simple manual forecast is created. Since some work is added alongside incoming delivery plans, this step is seen as partly existing.

2. Create initial production/supply plan

When new projects are under negotiation, the sales department checks with the production department if there is available capacity to take on the new project. For the ongoing work there are no bigger considerations for the production planning, and the manufacturing is mostly driven by suggestions from the ERP system. However since some consideration is given to production constraints this step is evaluated as partly existing.

3. Create consensus delivery and production plan

The sales and production departments have a good communication during the project meetings, and every other week the top-management has a meeting where managers from production, purchasing, marketing, among others are included. During these meetings it is easy to discuss any imbalances or problems between the sales, production and purchasing plans. However there is no formal meeting structure concerning the planning process and this is why this step is seen as only partly existing.

4. Implement the plan

Top-management are involved when making decisions regarding investments in new machinery etc. However, there are no formal executive meetings for implementation of a future plan, issues are discussed as they arise. Production plans are mostly initiated in the ERP system from the delivery plans on a day-to-day basis. These are the reasons for why this step is seen as only partially fulfilled.

5. Measure the plan
Company B have started using the FAI tool but not on a regular basis to measure forecast accuracy and therefore this step is regarded as missing.

S&OP maturity

In this section the level of maturity regarding Company B´s S&OP process is mapped into Grimson and Pyke's framework.

Meetings and collaboration
For new projects Company B have meetings every week where both production and sales participate and share information and try to resolve possible problems. The same people are also participating during the top-management meetings, resulting in good communication and information sharing regarding both sales and operations. However there are no formal S&OP meetings concerning the whole planning process which would be needed in order to reach stage three. Company B is thereby classified as 2.5 for this dimension.

Organization
The awareness of S&OP is limited and there is more or less no formal process with a clear organization in place. Thereby, Company B doesn't reach further than stage 1 at this dimension.

Measurements
Company B applies common KPIs regarding their operational activities, such as inventory levels, lead-times and delivery performance, which motivates for maturity stage 2 regarding measurements. To reach a higher level more evaluations of forecast accuracy is required.

Information technology
Company B uses the delivery plans from customers as direct input into their ERP system. The information is shared and accessible for both production and sales. They are evaluated to be in stage 2 for this dimension since they have no software dedicated to the planning process.

S&OP plan integration
For Company B sales are mostly driving operations that are obligated to produce the volumes requested. However, some consideration is given to constraints in production, especially before committing to a new project, which then puts Company B at a level of 2.5 in this dimension.

Implications

Company B fulfills almost all the steps within the S&OP process to some degree, which mostly can be related to the company's small size. As already mentioned above, the size of the company facilitates communication between the different departments since everyone is located at the same site. However, no defined S&OP process is stated and the capacity planning for a long-term horizon is not always considered. Company B does find the delivery plans sent from customers reliable enough for their planning activities. However no continuous measurements of the quality of the delivery plans are performed, analyzes are conducted first when obvious greater changes are made by the customers. Due to the discontinuous evaluation it is hard to state if the delivery plans can be trusted for the demand

planning. However, due to the company's flexible production layout, it is possible to reduce the lead-time for critical items and thereby avoid any bigger consequences of changed delivery plans. From the survey it is though concluded that the company is experiencing problems regarding capacity increase in the aspect of both personnel and equipment. Problems regarding material availability do also arise due to long-lead time from suppliers. This motivates for a more structured S&OP process.

5.1.3 Company C

In this section Company C's planning process is mapped into the stated S&OP process. Further is the maturity level of Company C´s S&OP process mapped into the framework of Grimson and Pyke.

S&OP process structure

Even though Company C doesn't have a defined S&OP process, some of the steps included in the process partly exist. Figure 17 below gives a clear picture of which steps Company C practice today. The dotted steps represents steps that Company C practice to some degree, and the unmarked are steps that are missing.

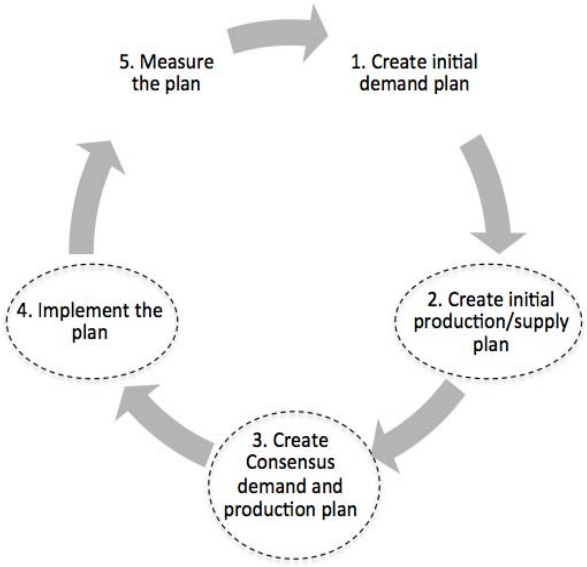


Figure 17. Company C's current S&OP process

1. Create initial demand/delivery plan

Company C uses their customers' delivery plans as the only input to their planning, and do not develop any demand forecasts on their own. Because of this, the initial step of the S&OP process is considered as lacking at Company C.

2. Create initial production/supply plan

The input to the production plans is the delivery plans that are directly entered into the ERP system. Furthermore, meetings are held twice a month with staff from both production and logistics where capacity planning is carried out on a 4-10 weeks horizon. Since no longer time horizon is investigated in any greater sense, this step doesn't exist to a full degree.

3. Create consensus delivery and production plan
As aforementioned, meetings are held every second week, with representatives from production and logistics present, where capacity planning is addressed. Furthermore are meetings on top-management level held where capacity for new products are discussed. However, meetings tend to focus on a short-term horizon, unless there are any certain circumstances, and sales doesn't attend these meetings, which also motivates why this step only exist to some degree.

4. Implement the plan
As previously mentioned, Company C integrate incoming delivery plans from customers directly into their ERP system, where their production plans originate from. Executive meetings with top-management are held in cases when new capacity investments are relevant. Otherwise no long-term plans are decided on, which is why this step doesn't exist to a full degree.

5. Measure the plan
Company C have started to perform some measuring of their forecast accuracy by using the FAI tool to evaluate incoming delivery plans but not to any significant extent as of yet. However, more extensive evaluations would be necessary to interpret this last step as existing in their planning process.

Process maturity
In this section the level of maturity regarding Company C´s S&OP process is mapped into Grimson and Pyke's framework.

Meetings and collaboration
Twice a month a meeting with representatives from the production department and the logistics department is held. During this meeting the resource capacities, regarding both machine-hours and man-hours, are discussed at a horizon of four to ten weeks ahead. However there are no formal S&OP meetings so the maturity level is evaluated as stage 2.5.

Organization
The awareness of the S&OP concept is limited and there is more or less no formal S&OP process in place so within this dimension Company C's maturity level doesn't go beyond the first stage.

Measurements
Company C measures inventory levels and productivity and perform some analysis with the FAI Analyzer tool to measure the quality of the delivery plans but not on a regular basis, which puts them in the second stage of the measurement dimension.

Information technology
Company C only uses their ERP system when planning production and supply, with the direct input from customers' delivery plans. It is though worth noticing that this mostly operates the day-to-day business and no real long-term planning are made within the system. However, due to the fact that the information is centralized and can be seen by the departments involved motivates for a stage 2 within this dimension.

S&OP plan integration

At Company C the delivery plans primary drives the production, nevertheless, some consideration is given to production constraints so the maturity level is considered to be at stage 2.5.

Implications

Company C is very similar to Company B in the aspect of size and ability to communicate in a simple manner. Furthermore, Company C doesn't consider the capacity demand for a long-term horizon either. The reason for this is mainly that the company doesn't trust the delivery plans more than for the nearest future, and can't see any possibility to receive or create any better information than they already get. Furthermore, due to the fact that Company C only supplies two big customers that send delivery plans for 12 months ahead, they can't see the need of developing own forecasts, at least not with any better results than their customers'. The company does however express an interest in creating some scenario simulation of the demand plan in order to identify possible risks regarding the production capacity. Continuous measurements of the quality of the delivery plans are also a lacking component here, which implies that the company can't be sure of the accuracy of the delivery plans. Especially for a long-term horizon with monthly planning buckets since the analysis mainly are made on a short-term horizon with the weekly buckets.

5.1.4 Company D

In this section Company D's S&OP process is described and mapped into the maturity framework of Grimson and Pyke.

S&OP process structure

Even though Company D doesn't have a defined S&OP process as of today, some of the steps included in the process do exist to some degree. Figure 18 below gives a clear picture of which steps Company D practice today. The dotted steps represents steps that Company D practice to some degree, and the unmarked are steps that are missing.

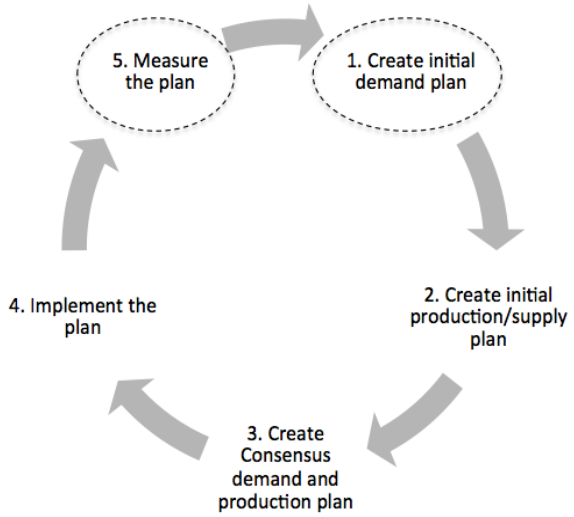


Figure 18. Company D's current S&OP process

1. Create initial demand/delivery plan
Company D creates their forecast once a month where the main input for the automotive segment is the delivery plans. For products where they don't receive any delivery plans Company D uses quantitative forecasting processes where sales history is the main input. Furthermore, during a monthly meeting with a big OEM customer some qualitative input to the forecast may be received as well. Due to the fact that Company D develops own forecasts and uses input from customers, however not for a long-term horizon, the initial process step is considered partially fulfilled.

2. Create initial production/supply plan
The only input that is given to the production sites is the incoming orders from the market companies without any consideration to capacity utilization. Thus, the market companies doesn't share any forecasts with the production sites, meaning that the production only make their plans as the orders are received in a short-term horizon. This step is therefore regarded as missing.

3. Create consensus delivery and production plan
As mentioned, the market companies only send orders to the production sites. Some communication does exist between the production sites and market companies but not in a very proactive way, consequently this step is considered missing.

4. Implement the plan
Since no long-term production- and supply plans are made this step is regarded as missing. Production is driven by orders sent from the market companies with a short-term horizon.

5. Measure the plan
Company D measures their forecast accuracy on a repetitive basis. Furthermore, the company is continuously using the FAI analyzer tool in order to measure the quality of the delivery plans sent from the OEM customers. No measurements connected to the planning process' effectiveness are however evaluated so this step is seen as only partly existing.

Process maturity
Here, the level of maturity regarding Company D's S&OP process is mapped into Grimson and Pyke's framework.

Meetings and collaboration
At Company D there is limited collaboration between sales/marketing and production. The departments are located at different sites and work separately. Communication only occurs when a problem arise on either side. Regarding this dimension Company D reaches stage 2.

Organization
As of today, the company doesn't have any S&OP organization, and the functions are working separate with limited communication, which puts them at the first stage at the organization dimension. However, Company D plans to implement a collaborative planning process, where it is likely that a central planning organization would be responsible for both consolidating demand and optimize production, this would increase the maturity significantly.

Measurements
In addition to common KPIs regarding the operational activities, Company D performs regular measures of the forecast accuracy and evaluates different kind of forecast methods. Furthermore, continuous analysis with the FAI analyzer tool is made. This puts Company D at stage 3 within the measurements dimension.

Information technology
Company D uses their ERP system for consolidation of plans for the Nordic sites, however different ERP systems are used at other Company D sites and a total consolidation of orders and production plans is not performed and therefore they only reach to stage 2 on the IT dimension.

S&OP plan integration
Due to the fact that the market and production sites functions as separate companies the integration is almost nonexistent. Production is left to try their best in meeting orders as they come in, without any beforehand warning, this puts Company D at stage 1 at this dimension.

Implications
The mapping of Company D differs quite significantly from the other companies in the reference group. This is mainly due to its size and spread where the company functions works more or less as separate companies. At Company D step 1 and 5 are performed while step 2, 3 and 4 are lacking in their S&OP process today. A forecasting process is in place and the results are measured on a regular basis. However different company functions work very separately and there is no integration of plans between the market companies and productions sites and communication takes place first when problems arise. This results in poor optimization of production and the ability to work proactively and further forces them to build unnecessary large safety stocks. The company also acknowledges the need of a more structured long-term planning process, where demand from the different market companies are consolidated and shared with the production sites. A project that aims of introducing a “collaborative planning” process is planned to be initiated for the European market, and could result in a process much similar to an S&OP process. If implemented, the maturity of the process would increase considerably and resolve many of the issues they struggle with today regarding their planning activities.

5.1.5 Company E
In this section Company E’s planning process is mapped into the stated S&OP process. Further is the level of maturity regarding Company E’s S&OP process evaluated.

S&OP process structure
Even though Company E doesn’t have a defined S&OP process, some of the steps included in the process exist. Figure 19 below gives a clear picture of which steps Company E practice today. The black-marked steps corresponds to the ones they have today, the dotted steps represents steps that Company E practice to some degree, and the unmarked are steps that are missing.

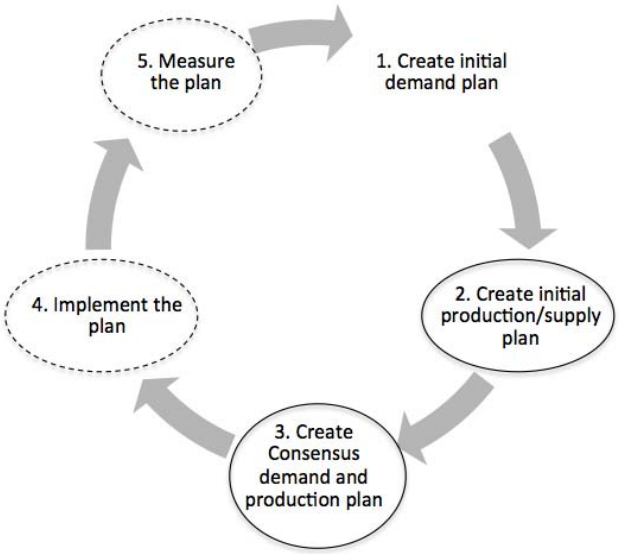


Figure 19. Company E's current S&OP process

1. Create initial demand/delivery plan

Company E uses the delivery plans from their customers, directly into their ERP system, which represents the only input to their demand plan. Since Company E doesn't make any adjustments of these plans, with market and customer knowledge, this step is interpreted as missing.

2. Create initial production/supply plan

The delivery plans are used as input to the production plans. During the Tuesday meeting available capacity in production is secured in order to meet the demand, this step is thereby interpreted as existing.

3. Create consensus delivery and production plan

During the Wednesday morning meetings relevant departments are represented and able to give input on capacity constraints, and sales department can be questioned in the case of sudden changes. This structured meeting motivates for why this step can be regarded as existing in Company E's planning process.

4. Implement the plan

In the case when issues are discovered during the Wednesday morning meeting actions are taken during the afternoon meeting. This may for example include change in shift forms etc. However, focus lies on the closest future, which is why this step not is completely fulfilled.

5. Measure the plan

Company E measures planned volumes with actual outcome for rolling 12 months. Some analysis of the delivery plans with the FAI tool is also made on a repetitive basis. However, more measurements of the forecast accuracy or evaluation of the process performance is necessary to fulfill this step completely.

Process maturity

In this section the level of maturity regarding Company E's S&OP process is mapped into Grimson and Pyke's framework.

Meetings and collaboration

Company E has a weekly formal meeting where representatives from relevant department participate. Furthermore they apply both pre-meetings and executive follow-up meetings, which put Company E at stage 3 within this dimension.

Organization

Company E doesn't have a formal S&OP-team but components of the process are managed by other positions. Company E had one person responsible for the planning process, but due to changes within the whole organization this role is not defined at the moment. However, due to the fact that this is identified as an area of responsibility Company E reaches stage 3 within this dimension.

Measurements

Measurements of how well operations meets the sales plans are made together with common KPIs regarding the operational activities are closely monitored, which motivates for maturity stage 2 within this dimension. Furthermore, some analysis with the FAI analyzer tool is made in order to evaluate the quality of the forecasts from the customers. However, more extensive and continuous controls of forecast accuracy would be necessary to reach a higher stage of maturity.

Information technology

Most information is centralized in the ERP system. However production planners are making some long-term plans using spreadsheets. These are however communicated to everyone during the weekly meetings. Furthermore, discussions regarding implementation of a more sophisticated software are in motion but due to the fact that Company E is right in the middle of a change of ERP system this is not possible as of today so at this point they are regarded to be in stage 2 for this dimension.

S&OP plan integration

Company E has a good collaboration when creating sales and production plans where considerations to capacity constraints are given. The creation of the plans is also made in a concurrent and collaborative process with pre-meetings and executive meetings. Thereby Company E reaches the third level regarding the S&OP plan integration.

Implications

Company E has a somewhat formalized planning process and performs all process steps to some degree except for step 1. Consequently their S&OP process maturity is relatively high. In step 1 however, the delivery plans are the only input for the demand plan creation and are direct input to their ERP system. A reason for this is that Company E only have a couple of big OEMs as customers and they send delivery plans that are considered the best possible guess for future demand. Moreover for a certain extreme high value component they have a special agreement with their customer where the customer covers the cost if they depart from the plans. Even though Company E have a relatively mature and structured process they still find it challenging to hire and train staff before the need exists according to the survey. This is mainly

due to the fact that the production has increased considerably within just a few years with many complications and a lot of down time as a result. This forces the company to put in extra shifts with short notice. As aforementioned, there is no measuring of forecast accuracy performed on the delivery plans, which makes Company E base their planning decisions on plans they don't know the accuracy of. Furthermore they see the need for a more advanced IT solution to support their planning process but are limited by a shift of ERP system in the near future.

5.1.6 Company F

In this section Company F's planning process will be mapped into the stated S&OP process and the maturity framework of Grimson and Pyke.

S&OP process structure

Even though Company F's doesn't have a stated S&OP process, some of the steps included in the process exist to some degree. Figure 20 below gives a clear picture of which steps Company F practice today. The dotted steps represents steps that Company F practice to some degree, and the unmarked are steps that are missing.

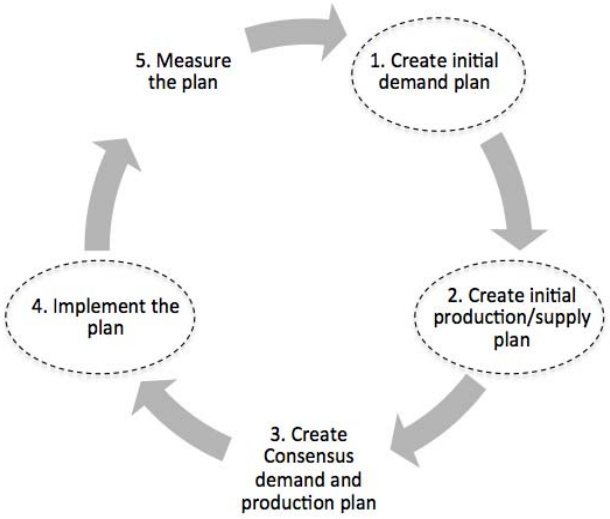


Figure 20. Company F's current S&OP process

1. Create initial demand/delivery plan

In the cases where delivery plans are received they are imported into the ERP system and accepted without any manual adjustments made. When delivery plans are not received forecasts have to be developed. This is performed by the system every week where the last six months are roughly mirrored for the next 12 months. A budget forecast is done every year and is based on indications from the customers. Since some forecast work is added alongside incoming delivery plans this step is considered partly fulfilled.

2. Create initial production/supply plan

Twice a week the capacity situation is evaluated for the next 20 days. Capacity checks for a longer horizon is made to some degree and therefore this process step is seen as partially performed.

3. Create consensus delivery and production plan
There are no planning meetings where sales and production participates. Communication between these departments occurs firstly when problems arise. Consequently this step is regarded as missing.

4. Implement the plan
The system develops the production plans and twice a week production plans are reviewed with a month's horizon regarding capacity. A budget plan for the coming year is also developed in corporation with customers and due to this, this process step is considered partially existing.

5. Measure the plan
Company F measures delivery performance but not forecast accuracy or other measures connected to the planning process and therefore this step is seen as lacking.

Process maturity

In this section the level of maturity regarding Company F's S&OP process is mapped into Grimson and Pyke's framework.

Meetings and collaboration
There is little communication between sales and production at Company F, it mostly happens first when problems arise and not proactively. Nevertheless there is regular communication between purchase and sales so this puts them in maturity level 2. In order to move to a higher level they would need to apply formal S&OP meetings.

Organization
There is more or less no one performing any S&OP tasks within the company and the awareness of the S&OP concept is limited, they are therefore evaluated to be in maturity level 1 for this dimension.

Measurements
Delivery performance is measured on a regular basis and Company F keeps track of their inventory levels. There are, however, no measurements in place to measure the planning process and the company is therefore placed at maturity stage 2 for this dimension.

Information technology
Company F doesn't apply any more sophisticated software for their planning process more than their ERP system, where some long-term forecasting is made. This puts Company F at the second level within the IT-dimension.

S&OP plan integration
Sales are mostly driving production with little communication between those two departments. However due to incoming delivery plans and forecasts, production have a chance to prepare for future incoming orders and the maturity level is therefore set to stage 2. To reach a higher level they need to consider production constraints more.

Implications

Due to the fact that Company F supplies to different industries and different kind of customers, including distributors and retailers it is necessary to develop own forecasts since these customers only send orders and no long-term delivery plans. However, for their automotive customers, the delivery plans from the OEMs are broken down with the BOM by the tier 1 supplier and are then sent to Company F. Changes in the delivery plans are thereby a bit delayed when reaching Company F. Like most other investigated companies, Company F doesn't measure the forecast quality or the quality of the delivery plans. Since this is not continuously followed up, it is difficult to state that another approach would result in a increased forecast quality. Even though Company F is quite small, their production and headquarter are separated, which complicates the interaction between the sales and the production departments. According to the answered survey, communication occurs first when problems has arisen. From the survey it can also be concluded that the company finds it difficult to adjust production capacity in time, regarding both equipment and personnel. However, due to the extremely long lead-times from their suppliers of certain raw material (18 months), the material availability is of more crucial character than production capacity. Due to this, Company F is forced to build big inventories, resulting in a high level of tied-up capital as well as high inventory costs.

5.1.7 Company G

In this section Company G's S&OP process is mapped into the stated process and the maturity framework stated by Grimson and Pyke.

S&OP process structure

In Figure 21, Company G's S&OP process structure is illustrated. The black-marked steps represent the process steps that Company G practice today.

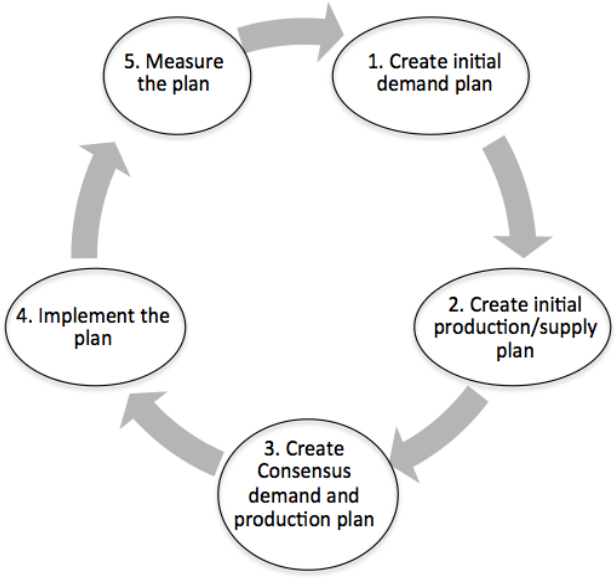


Figure 21. Company G's current S&OP process

1. Create initial demand/delivery plan
Company G develops forecasts every month with a 24-month horizon based on sales history and market intelligence added by forecast collaborators. Furthermore, once every quarter a macro-analysis is made which is used to fine-tune the demand plan. Since long-term forecasts are developed in a structured way the first process step is considered completely fulfilled.

2. Create initial production/supply plan
Both production capacity and supply capacity is evaluated and secured in order to be able to meet the developed forecast. If there are any problems in meeting forecasted demand this will be discussed at the review meetings held every month. Due to the fact that a long-term plan is investigated and reviewed this step is interpreted as fully existing.

3. Create consensus delivery and production plan
A review meeting is held every month where plans are accepted and possible issues are raised with participants from different departments affected. If more severe issues than what can be resolved at these review meetings arise, a so-called escalation will be carried out where the problem is elevated to a higher level within the company. As meetings are held with participants from different departments on a regular basis this step is reviewed as fully existing.

4. Implement the plan
The meetings during an escalation represent the final implementation and acceptance of the created plans. These plans represent the boundaries for more short-term plans and are communicated to relevant parties. This fourth step can thereby be regarded to exist to a full extent.

5. Measure the plan
Company G measures forecast accuracy on a regular basis and also other measures connected to the effectiveness and efficiency of the S&OP process like Process Performance Indicators (PPI) and are therefore viewed as fulfilling this process step.

Process maturity
In this section the level of maturity regarding Company G's S&OP process is mapped into Grimson and Pyke's framework.

Meetings and collaboration
Company G applies monthly formal S&OP review meetings with participation from different departments. Possible arisen issues are discussed and most often resolved, otherwise the problems are elevated to a higher level. These formal meetings do thereby put Company G at stage 3 regarding this dimension. Key customers and suppliers do not participate actively in those meeting, which is why a higher stage of maturity for this dimension is not reached.

Organization
Company G has a formal S&OP team with clearly stated responsibilities within the three main areas of the S&OP process; forecasting, manufacturing supply planning and supply capacity planning, The concept of S&OP is known and understood within the central parts of the company, however more

acceptance for the process at every location would be necessary in order to reach the highest stage of maturity regarding the organization. Company G is thereby placed at stage 4.5 at this dimension.

Measurements
Company G measures forecast accuracy on a regular basis and deviations are investigated and the forecast responsibles are somewhat hold accountable. Furthermore are process performance indicators (PPI's) and key performance indicators (KPI's) connected to the S&OP process measured and evaluated, which thereby puts Company G at Stage 3.5 regarding the measurements.

Information technology
Company G uses a off-the-shelf software for their sales and operations planning process. Thanks to the software it is also possible to make what-if scenarios. This puts Company G at the third level within the dimension of information technology.

S&OP plan integration
Sales forecasts are being developed bottom-up and consideration is given to production constraints to a high degree. There is a relative high level of integration between sales and production through review meetings and escalation meetings and the S&OP concept is well established. This results in placing Company G at stage 4.

Implications
Company G has a formalized S&OP process and are considered to perform all process steps and the process maturity is thus regarded as high. Consequently Company G doesn't suffer from problems due to the lack of a long-term planning process to the same degree as other companies in the study regarding acquire and install new machinery in time and hire and train new employees before the need exists, according to the survey result. Furthermore, the company has been able to improve their forecast accuracy during their work with the S&OP process. Company G is also the only company of the investigated group that doesn't use the delivery plans in any greater extent since delivery plans doesn't exist for all customers, when creating their forecast. Instead, the demand plan is based on statistical analysis of sales history.

5.2 Summary and discussion of mapping analysis
In this section a summary and a discussion of the findings regarding both the S&OP process structure and the S&OP maturity of the investigated companies are presented and illustrated.

5.2.1 S&OP Process Summary
In Figure 22 below, a summary of the performed process steps for the investigated suppliers is presented. The different companies differs somewhat regarding which steps that are included in their current planning processes, and which steps that thereby can be filled. A discussion regarding the difficulties and possibilities, related to the specific context, within each step is also presented below.

Create initial demand plan

The companies that perform an actual forecasting process are Company A and Company G, whereas the other companies mainly rely on the delivery plans sent from their customers. The main rationale for developing own forecast is that the companies doesn't receive long-term delivery plans from all of their customers, and therefore have to create an additional forecast in order to evaluate the possible demand. However, for the suppliers that only supplies to the big OEMs, the delivery plans are used as the only input for future demand. This transparency is in many cases very helpful for the suppliers since they can see the expected demand for a long-term future. Even though the quality of the forecast may vary quite significantly, the suppliers consider these delivery plans to be the best possible guess available for future demand. To develop own forecasts is thereby not believed to increase the forecast quality to any greater extent. Furthermore, not following the delivery plans is regarded risky since the suppliers are blamed in the case where they can't deliver. Otherwise, the OEMs are accountable for their own forecasting deviations to a greater extent. Companies that produce low-value items to big automotive OEM's, which include most of the investigated companies, are also very dependent on their customers for their own survival. In turn, the suppliers are obligated to fulfill the demands stated by the customers, without being able to influence in the other direction to any significant degree. Furthermore, the automotive industry is deeply connected to the economic climate and cyclical changes can cause rapid demand fluctuations (Shahabuddin, 2009). Due to this unpredictable market, most suppliers are reluctant to use sales history, as advised by literature (Jonsson & Mattsson, 2009; Tudorie & Borangiu, 2011) when creating a future demand plan. This mindset does further motivate the suppliers' belief that it is better to use the delivery plans from the customers than creating their own forecasts. The S&OP literature also suggest that the created demand plan should be adjusted with marketing activities and discounts in order to increase the demand for certain products (Jonsson & Mattsson, 2009). This can be a good strategy in order to get a more satisfactory utilization of the production. However, for suppliers within the automotive industry, this is not possible. The suppliers depend on what the customers demand for their final products, and it is obviously therefore not possible to promote any other components. For those suppliers that provide customers within other industries this may be a more suitable strategy. However, it is of significant importance that all kind of demand increases from promotion activities are included in the demand plan that is shared with the production and supply department.

Create initial supply/production plan

The next step is carried out a bit different at the different companies. Company A, E and G, that actually have a stated forecasting or S&OP process, fulfill this step to a larger extent than the rest of the companies by considering capacity availability for a long-term horizon. For the other companies, i.e. Company B, C, D and F, the production tries to meet the incoming orders in best way possible. Some rough capacity checks are sometimes made for a longer horizon, e.g. when new projects are discussed. According to the survey the companies are experiencing difficulties with acquiring both personnel and machinery in time to meet an increase in demand, which to some degree also applies to Company A and E. In turn, this implies that this step needs to be improved. The reason for the shortsighted focus can in many cases be related to the distrust in the delivery plans. Hence, the companies don't find the delivery plans reliable enough at a long-term horizon to make decision based on them.

Create consensus plan

Regarding the consensus meeting, the possibility of fulfilling this step is to some degree related to the specific company context. Some of the suppliers are small in comparison and both sales and production departments are located at the same place, which increases the possibility of continuous meetings with the involved parties and hence a better integration of plans. For the larger companies with wider spread it is more difficult to communicate. These companies are thereby in a bigger need of introducing formal consensus meetings.

Implement the plan

Both Company A and Company G has fulfilled the fourth step due to the fact that the plans they have made are used as decision support for long-term decisions that has to be made. These plans do thereby constitute a framework for the more short-term plans. The other companies don't really consider the long-term horizon, and capacity increases/decreases are managed as the problems arise in a bigger sense.

Measure the plan

It is clear from Figure 22, that the step with the greatest improvement potential for all suppliers is the measurements. Most companies apply common KPIs, such as inventory levels and delivery performance, etc. However, the forecast quality is rarely evaluated. The potential for improvement within this step is thereby significant, especially due to the fact that most companies has access to the FAI analyzer tool. According to the survey, most companies do acknowledge the importance of measuring the forecast accuracy, which further motivates why this step can and should be developed. Due to the fact that most companies solely rely on the delivery plans from their customers it is of even greater importance that these are evaluated, since this is what the companies base their decisions on. Such evaluation is also of importance in order to know how accurate or inaccurate these plans are, or if it is more helpful to use any other type of data or input for the demand plan creation.

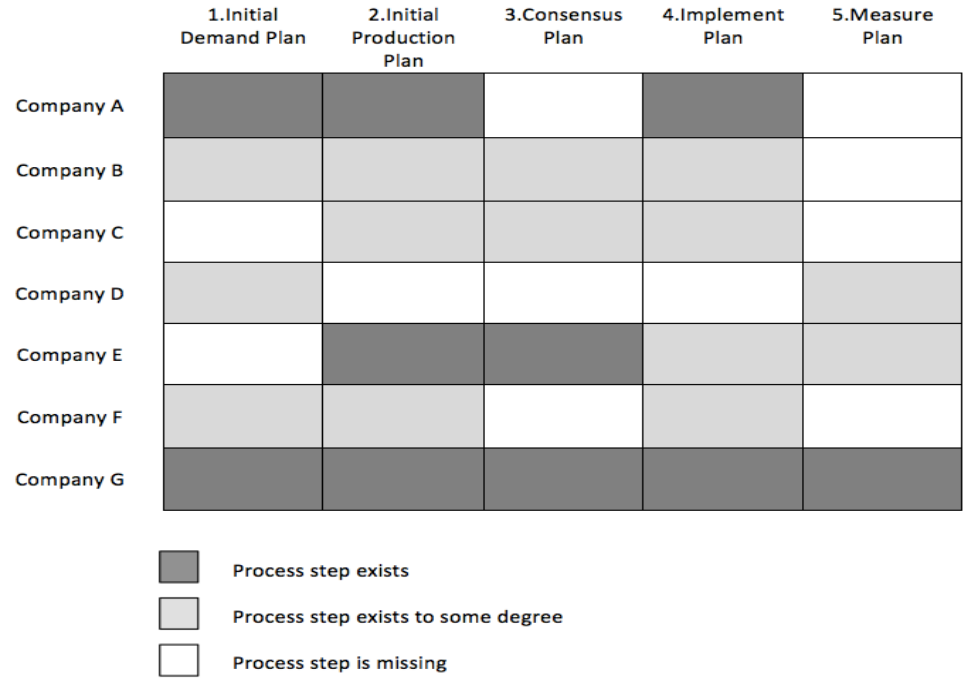


Figure 22. Summary of companies' current S&OP processes

5.2.2 S&OP maturity mapping analysis

In Figure 23 below an overview of the overall result from the mapping of the companies' S&OP process maturity levels can be seen. The maturity level differs quite a lot for some dimension while not as much for other dimensions. Below is a summary of the maturity mapping and a short discussion regarding the result presented.

Meetings and collaboration

The only two companies that have a structured meeting procedure today are Company E and Company G. At some of the smaller companies, that have different functions at the same location, meetings and communication is not formalized but carried out when needed, which also is argued in the previous chapter. For the other companies, where this is not the case, collaboration is more difficult due to the actual distance between departments. The need of more formalized meetings is therefore greater for these companies, especially for Company A and Company D. However, an increased formalization of the meetings for the smaller suppliers may also be of importance in order to ensure that the long-term planning issues actually are discussed and not forgotten to the benefit of the more short-term horizon.

Organization

For the smaller companies in the study there exist no S&OP organization and the awareness of the S&OP concept is limited. At Company A and Company D the need for a more formalized process is recognized but not developed as of yet. Company E has a somewhat formalized S&OP organization but Company G is the company that has the most mature S&OP organization. However due to different sizes and complexity of the companies the need of a formalized organization varies. The need is greater for the

larger companies with several sites than for the smaller companies where the process more easily is managed.

Measurement
Most companies investigated don't apply any measurements connected to the S&OP process or measure forecast accuracy. Company D and Company G are the only two companies who measure forecast accuracy on a regular basis, in addition Company G measures Process Performance Indicators and are therefore the only company that have measurements connected to the process' effectiveness. However almost all companies regard measuring the forecast accuracy as important according to the survey. Since many companies use the delivery plans as their only input for their demand plan it is highly essential to measure and evaluate the delivery plans in order to know what their decisions are based on.

Information technology
To get a higher maturity level than stage 2 for the IT dimension the company needs to have a software dedicated to the S&OP process itself and Company G is the only company that does. The other companies use their ERP systems and maybe some spreadsheets in addition. In most cases this is sufficient for the planning purposes as long as the information is centralized and consolidated between the different departments. It is also argued by literature (Lapide, 2004/2005) that it is essential that a proper process is in place before an investment in a more advanced IT system is made. However, for companies with a complex planning situation, i.e. operating at several markets with a number of different sites and a large product assortment it is more motivated for such investments. This applies especially for Company A and Company D that has uttered this need themselves. However, Company E has also expressed interest in more sophisticated S&OP software, which can be motivated by their already mature process.

S&OP plan integration
At Company A and Company F sales are mostly driving production but plans are shared while Company D send orders to their production sites with little beforehand warning and does not share delivery plans or forecasts. Company C and Company B has more integration of plans and some possibility to adapt to production's constraints. At Company E there is more integration of plans and interaction between departments. Company G has the highest level of S&OP plan integration where greater consideration is given to production constraints. The level of plan integration is somewhat connected to the company size and spread and the overall maturity of the S&OP process. The companies with the highest level of maturity regarding plan integration are the companies with the most mature process followed by the smaller companies having only one site. The companies with more than one site and no formalized process have the lowest maturity level.

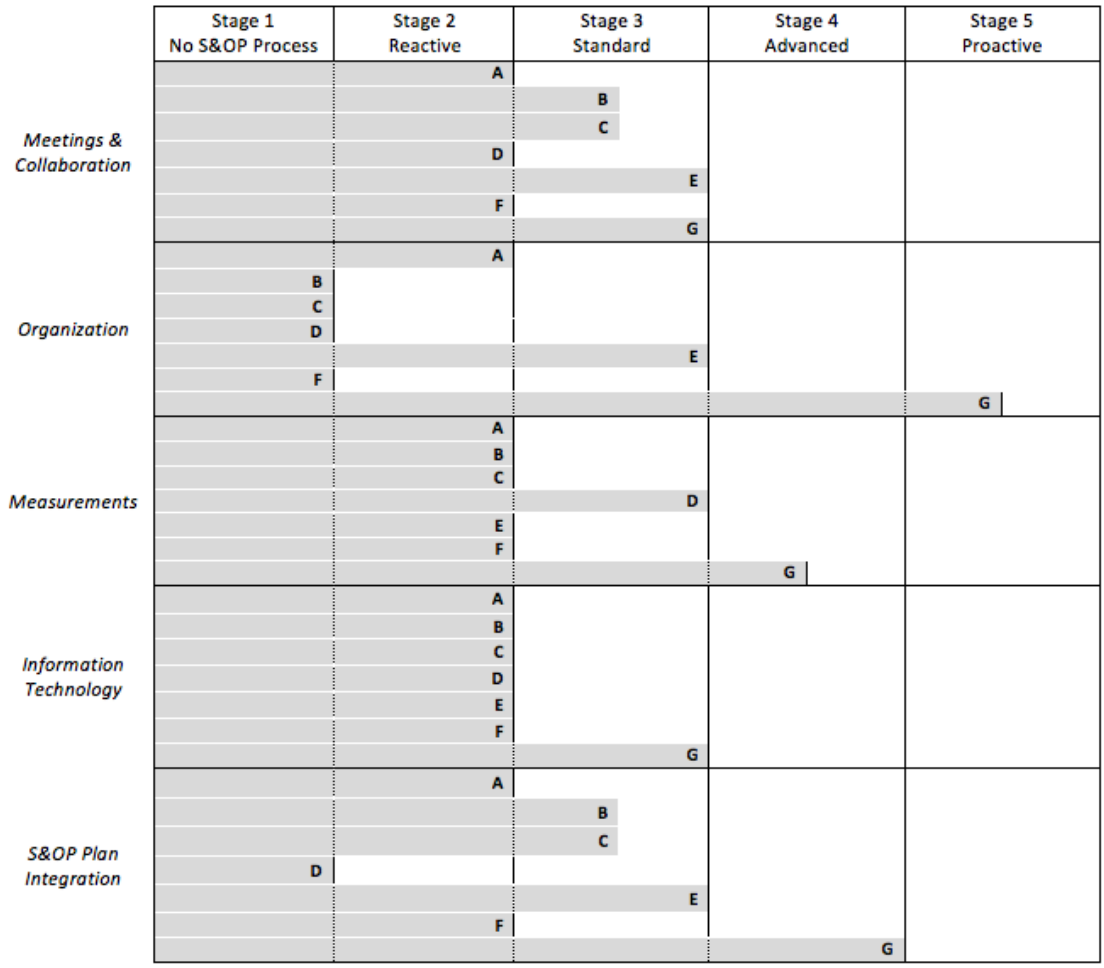


Figure 23. Summary of the companies' maturity levels

5.3 FAI Analyzer tool within S&OP

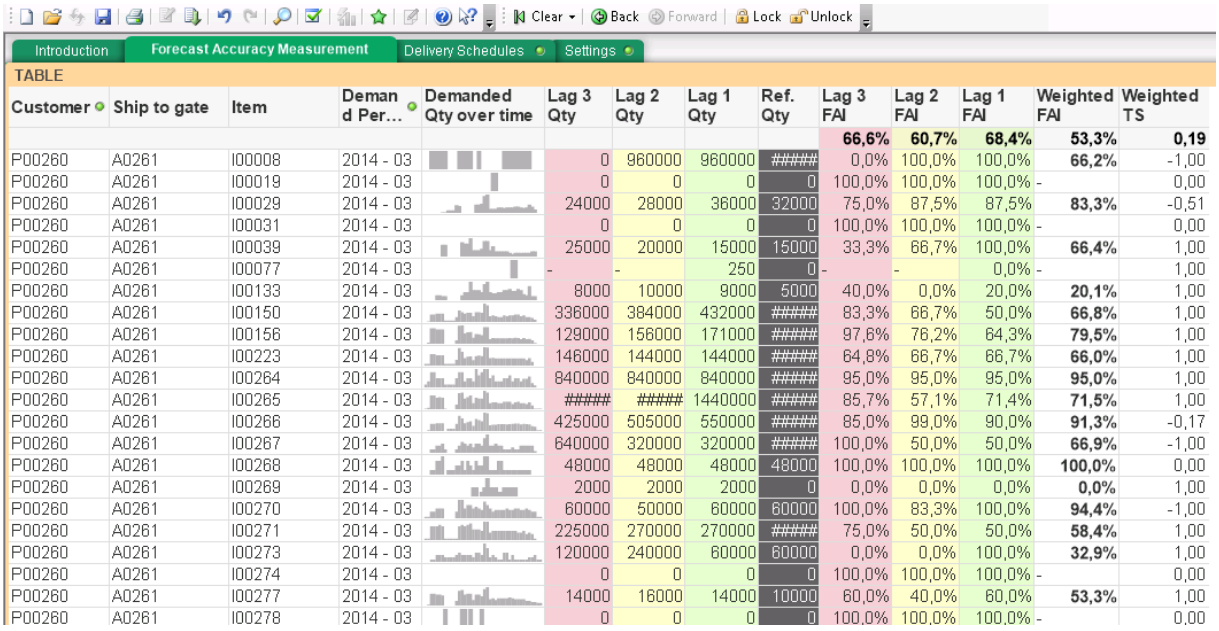
Most companies that have implemented the FAI Analyzer tool have applied it for the purpose to discover systematic errors that can be resolved, by communicating these deviations to the customers. For planning purposes these findings may also be valuable to some extent. If clear patterns for certain products or customers can be identified, these can be used as input for the internal demand plan creation or inventory level settings. However, it is always recommended to try to go back to the source of error and try to improve the forecasting quality instead of adjusting the delivery plans as a supplier.

The FAI value can give an understanding of how much the deviations tend to shift and thereby indicate how flexible the production capacity must be. This analysis is therefore appropriate to perform within the fifth step in the S&OP process; measure the plan. Two different aspects are as mentioned important. First, to discover systematic errors that may be resolved, second to give an understanding about the fluctuations. Due to the fact that the FAI value for an aggregated level calculates the average of the

individual FAI values for the included items, the FAI value can hence be relatively low even though the total volume for the concerned items hasn't changed that much. For this purpose, it is thereby recommended to apply the FAI application for single items. In order to be able to perform this analysis on a repetitive basis within reasonable time duration some delimitations has to be made, concerning which items to investigate.

Systematic Errors

In order to discover any possible systematic errors, critical items where problems has arisen should first be analyzed. This includes products with delivery issues as well as products where the inventory levels are higher than desired. For this analysis the week-application is most suitable since the usage of a too big period, e.g. month, can hide strange fluctuations within the chosen period. In addition to the FAI value, the visualizations of the demanded quantity over time are a valuable output from this analysis (see the fifth column "Demanded Qty over time" in Figure 24). In order to get a quick overview, it is possible to choose a big number of items for the visual analysis, and from that identify the most problematic items. Any strange deviations should be lifted to the customer sending the delivery plans.



Customer	Ship to gate	Item	Demand Per...	Demanded Qty over time	Lag 3 Qty	Lag 2 Qty	Lag 1 Qty	Ref. Qty	Lag 3 FAI	Lag 2 FAI	Lag 1 FAI	Weighted FAI	Weighted TS
									66,6%	**60,7%**	**68,4%**	**53,3%**	**0,19**
P00260	A0261	I00008	2014 - 03		0	960000	960000	#####	0,0%	100,0%	100,0%	**66,2%**	-1,00
P00260	A0261	I00019	2014 - 03		0	0	0	0	100,0%	100,0%	100,0%	-	0,00
P00260	A0261	I00029	2014 - 03		24000	28000	36000	32000	75,0%	87,5%	87,5%	**83,3%**	-0,51
P00260	A0261	I00031	2014 - 03		0	0	0	0	100,0%	100,0%	100,0%	-	0,00
P00260	A0261	I00039	2014 - 03		25000	20000	15000	15000	33,3%	66,7%	100,0%	**66,4%**	1,00
P00260	A0261	I00077	2014 - 03		-	-	250	0	-	-	0,0%	-	1,00
P00260	A0261	I00133	2014 - 03		8000	10000	9000	5000	40,0%	0,0%	20,0%	**20,1%**	1,00
P00260	A0261	I00150	2014 - 03		336000	384000	432000	#####	83,3%	66,7%	50,0%	**66,8%**	1,00
P00260	A0261	I00156	2014 - 03		129000	156000	171000	#####	97,6%	76,2%	64,3%	**79,5%**	1,00
P00260	A0261	I00223	2014 - 03		146000	144000	144000	#####	64,8%	66,7%	66,7%	**66,0%**	1,00
P00260	A0261	I00264	2014 - 03		840000	840000	840000	#####	95,0%	95,0%	95,0%	**95,0%**	1,00
P00260	A0261	I00265	2014 - 03		#####	#####	1440000	#####	85,7%	57,1%	71,4%	**71,5%**	1,00
P00260	A0261	I00266	2014 - 03		425000	505000	550000	#####	85,0%	99,0%	90,0%	**91,3%**	-0,17
P00260	A0261	I00267	2014 - 03		640000	320000	320000	#####	100,0%	50,0%	50,0%	**66,9%**	-1,00
P00260	A0261	I00268	2014 - 03		48000	48000	48000	48000	100,0%	100,0%	100,0%	**100,0%**	0,00
P00260	A0261	I00269	2014 - 03		2000	2000	2000	0	0,0%	0,0%	0,0%	**0,0%**	1,00
P00260	A0261	I00270	2014 - 03		60000	50000	60000	60000	100,0%	83,3%	100,0%	**94,4%**	-1,00
P00260	A0261	I00271	2014 - 03		225000	270000	270000	#####	75,0%	50,0%	50,0%	**58,4%**	1,00
P00260	A0261	I00273	2014 - 03		120000	240000	60000	60000	0,0%	0,0%	100,0%	**32,9%**	1,00
P00260	A0261	I00274	2014 - 03		0	0	0	0	100,0%	100,0%	100,0%	-	0,00
P00260	A0261	I00277	2014 - 03		14000	16000	14000	10000	60,0%	40,0%	60,0%	**53,3%**	1,00
P00260	A0261	I00278	2014 - 03		0	0	0	0	100,0%	100,0%	100,0%	-	0,00

Figure 24. Demanded quantity over time

Fluctuations

In order to be aware of demand fluctuations, another selection is appropriate. This analysis should focus more on items with a high volume-value and items going through bottlenecks in the production. In regard to the S&OP process it is most suitable to use the month-application and analyze the FAI value for critical decision points, including production capacity increase/decrease and material procurement decision points. This analysis gives an indication of how much the demand may change and thereby how flexible the production has to be. These numbers can then be the basis for simple what-if simulations in the creation of the production/supply plan or function as parameters to adjust the inventory levels. However, big deviations should always be lifted to concerned customer in order to attempt to improve the forecast quality.

This analysis can also be of value in order to identify for what time-horizon the deliver plans can be trusted and used as only input for the demand plan. As illustrated in Figure 10 and Figure 11 in chapter 4.2, the delivery plans can be of significant lower quality at a long-term horizon compared to the short-term horizon. This can indicate if it is suitable to rely solely on the delivery plans when estimating future demand.

FAI analyzer tool development
The way the FAI tool is configured today it can be of some use in the S&OP process, as stated in the section above. However there is great potential for development of the FAI tool in order to better support the S&OP process than what the current version is able to today. A suggestion of how this could look like and what functions this developed version could have are presented in Appendix 7.

5.4 Planning parameters

The suggestions of appropriate planning parameters are based on the outcome of the workshop where the subject was discussed. The literature framework is also regarded to somewhat confirm and support the outcome.

5.4.1 Planning Frequency

According to literature, a monthly planning frequency is suitable for this kind of process. However, Jonsson and Mattsson (2009) also mentioned that the company context needs to be considered when deciding on this parameter. Lead-time, market dynamics and frequency of new product launches need to be taken into account. During the workshop, it was settled that a monthly planning frequency is sufficient for this type of context since applying a lower planning frequency, with for example a quarterly interval, could in some cases be more time consuming in total. One of the investigated suppliers had the experience that a quarterly planning frequency implied a long startup time of the process, due to big market changes, since the last planning session. More frequent planning sessions, i.e. monthly frequency, did thereby result in a more dynamic process.

5.4.2 Planning object

Jonsson and Mattsson (2009) state that since S&OP is focused on long-term planning the level of detail of the planning object should be quite low. However according to Grimson and Pyke (2007) many companies plan on a more detailed level such as on single SKUs and this is also true when looking at the investigated companies. The outcome of the workshop was that depending on company context the planning can either be done on SKU level or on aggregated level. However, when planning on a product group level it is important that it is possible to disaggregate the product groups to SKU level. Appropriate product groups should, in that case, be identified and can for example be based on relevant capacity dimensions such as products with same inbound material or products going through the same line or cell. During the workshop, a suggestion of applying product groups for low volume products with a high number of product variants, while planning on SKU level for products with high volume and fewer numbers of variants. Thus for this planning parameter the literature and the empirical data matches.

5.4.3 Units of capacity

Unit of capacity is highly connected to planning object and company context and specific ERP set-ups. An entire workshop or a whole assembly line can be used as units for planning (Jonsson & Mattsson, 2009). One common set-up is to appoint planning groups in the ERP system from where available capacity in machine hours easily can be found. It is also easy to link all products going through that certain planning group. For companies with a more uniform production, units such as meters or kilograms are more suitable. This is also recommended for companies where the inbound material is of more critical character than the capacity in production.

5.4.4 Planning Horizon

Both literature (Jonsson & Mattsson, 2009), and discussions from the workshop recommends that the planning horizon should be adapted to the company's specific context. Parameters that need to be considered is the lead-time for capacity increase/decrease in production, which regards both manning and machinery, but also the longest accumulated product lead-time. This will consequently differ significant between the investigated suppliers. For example, Company F's longest lead time from one of their steel suppliers is 18 months, hence a planning horizon of 18 months plus the in-house lead time is recommended. However, a minimum of 12 months should be applied due to the fact that this type of process is deeply connected to the budgeting (Jonsson & Mattsson, 2009).

5.5 Suggested guidelines for suppliers in the automotive industry working with S&OP

In this section, a discussion regarding how the different steps in the S&OP process can be performed for the investigated companies in general is presented. Further is a short discussion about appropriate maturity level given.

5.5.1 Suggestions for S&OP process steps

Suggestions for how the different steps included in the S&OP process should be performed are presented in this section. Considerations to the specific context of companies supplying in the automotive industry is given.

1. Create initial demand plan

The first step in the S&OP process is to create an initial demand plan where future sales should be estimated in order to be able to meet this demand in an efficient way. As of today, most investigated companies use the delivery plans received from their customers as the only input to estimate future demand. These are not perceived as good enough on a long-term horizon and few companies feel that they can rely on these for decision-making. However, the companies are considering the delivery plans the best guess available. Nevertheless in order to realize to what degree the delivery plans can be trusted the forecast accuracy of the plans must be measured and evaluated. As illustrated in chapter 4.2 the forecast accuracy for a long-term horizon can be considerably low and if so additional input is needed for the demand plan creation. It is possible that the plans are good enough for a six months horizon but not for month 6-12.

The first step when developing the demand plan is to download the existing order stock from the current delivery plans and aggregate these into a monthly demand for the whole planning horizon. An example of how this may look is illustrated in Figure 21, where a simple spreadsheet is used. The planning horizon is 12 months in this example. Using spreadsheets can be sufficient for this purpose in many cases. However, for some companies it may be unmanageable to keep it in a spreadsheet due to a very large number of products, customers and markets. The risk of errors and human mistakes increases with the complexity of the spreadsheet, an opinion expressed by Company A that currently uses this method. More sophisticated software, dedicated to the forecasting process, may in such case be necessary.

			Working days	20	20	23	19	22	19	22	22	22	21	22	21
			Total	1 662 500	1 715 000	1 543 000	1 225 000	665 000	505 000	130 000	138 000	0	0	0	0
Customer	Part no	Supplier	Other Inf.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
A	1	K	X	0	0	0	0	0	0	0	0	0	0	0	0
A	2	L	X	8 000	16 000	12 000	20 000	4 000	15 000	8 000	0	0	0	0	0
A	3	L	X	90 000	135 000	120 000	125 000	120 000	90 000	122 000	138 000	0	0	0	0
B	3	L	Y	15 000	9 000	0	0	0	0	0	0	0	0	0	0
C	3	L	Y	30 000	15 000	0	0	0	0	0	0	0	0	0	0
C	4	M	X	700 000	600 000	630 000	40 000	0	0	0	0	0	0	0	0
C	5	N	Z	60 000	90 000	111 000	105 000	90 000	0	0	0	0	0	0	0
C	6	O	Z	0	0	0	270 000	220 000	200 000	0	0	0	0	0	0
D	6	O	Y	172 500	84 000	0	20 000	0	0	0	0	0	0	0	0
D	7	P	X	587 000	765 000	670 000	645 000	231 000	200 000	0	0	0	0	0	0
D	8	Q	Z	0	1 000	0	0	0	0	0	0	0	0	0	0

Figure 25. Example of aggregated demand plan

From the current order stock the company should identify its customers and how long horizons the received delivery plans have, for each of them. This may sound obvious, but if no such analyze is carried out the order stock can be appear rather misleading. For example, if one company supplies the same product to two different customers where one customer sends delivery plans for 12 months ahead and the other for 6 months it can be perceived as if the demand is decreasing in 6 months, which in reality isn't true. This is especially important for companies that supplies to others than Nordic based OEMs, who usually are more generous with their future plans. Furthermore it is important to secure that the demand plan covers the total planning horizon. In the case where the planning horizon is 18 months, the delivery plans of 12 months won't be enough. Some additional input must thereby be used in order to create a complete demand plan. In Figure 26 below, an example of the current order stock, for one of the investigated supplier is illustrated. The graph clearly shows that additional forecasting is needed since the received delivery plans doesn't cover the next coming 12 months.

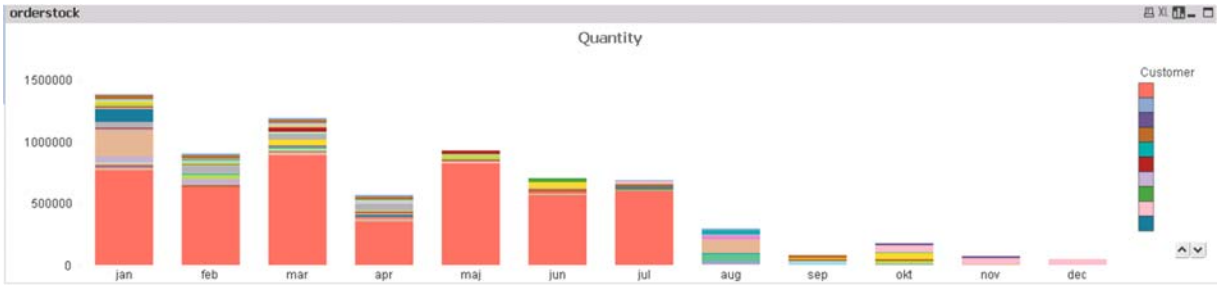


Figure 26. Example of current order stock

When the incoming delivery plans doesn't cover the total planning horizon or when the quality of the delivery plans isn't considered good enough for more than a few months, additional forecasting must be performed in order to cover the total planning horizon. For this step historical sales data, production

programs and other customer information can be used as input. Since the demand usually is dependent on more factors, such as economic climate, increased competition etc. (Shahabuddin, 2009) sales history should be used with caution. However, it can be the basis for a forecast which then can be adjusted with information received from the customers.

Different demand scenarios should be created. This can be initiated by indications from the customers regarding future demand increases etc., which they have not dared to put in the delivery plans yet. The FAI Analyzer tool is a valuable source of information for scenario creation. The FAI value identifies a level of uncertainty for a particular product at a determined horizon. This deviation may be appropriate to use when creating demand scenarios in order to get an indication of how much the demand may differ. For example, in the case where a certain product has a FAI value of 60% at a two-months horizon (which is a critical decision point for this particular source of capacity), it is recommended to bring this to the supply/production plan and simulate if this demand can be met.

Lastly, considerations to new product launches and products being faced out should be given. Sudden demand decreases/increases for certain products can thereby be understood and prepared for.

2. Create initial supply/production plan

The purpose with creating a production plan is to ensure capacity and supply to be able to meet customers' long-term demand. The input to the production plan should be the developed demand plan. The first step is to identify available capacity, and second to identify critical lead times for production capacity increase or decrease (i.e. lead times for machinery acquisition, hiring or firing and material acquisition). The demand plan should then be compared with available capacity for stated planning horizon, covering at least 12 months. Gaps between demand and capacity should then be identified. Reconciliation with the company's most important suppliers should also be made in order to ensure their ability to supply the future demand of incoming material. Based on identified gaps, suggestions for how to close these gaps should be developed, e.g. bring in extra staff, change inventory levels, etc. Identified gaps and suggested actions should be brought to the consensus meeting.

Risk analysis based on the created demand scenario analysis in the demand plan should be executed. Different demand scenarios could then be simulated in order to identify possible capacity issues if the created demand plan might change in some scale. This analysis should also be brought to the consensus meeting in order to discuss the possible risks that the company might face, and if any actions should be carried out. To facilitate this form of analysis a tool support might be needed.

3. Consensus plan

A consensus meeting regarding the whole company's planning situation should thereafter be executed. After the development of the demand- and production plans for the individual sites, they should be aggregated prior to this meeting. However for smaller companies there might just be one sales- and one production plan to consider. Participants from relevant departments should attend which implies participants from sales/marketing, production, logistics and finance. It is important to determine who from the different departments that should participate in order to make someone responsible for each role, and thereby increase the accountability for the whole process. In smaller companies, this can be within the responsibilities of the top-management. At this meeting unresolved issues and possible actions should be

discussed. The meeting will also give the opportunity to question and challenge the demand plan and discuss the possible scenarios, which in turn will result in a greater acceptance and credibility of the plan.

The first part at this meeting should be to review the results from the measurements, done in the last process cycle, in order to evaluate and draw possible learnings from the results. The evaluation should include reviewing forecast accuracy, planned inventory levels with actual levels and capacity utilization. Reasons for the possible discrepancies should also be brought up. This part is very important in order to be able to continuously improving the process.

Next should the demand plan, including possible demand scenarios, and the production plan be presented and discussed. Input for the discussion are identified capacity gaps, when for example a bottleneck is identified to have too limited capacity for expected demand, other issues and what actions to take to mitigate these. Actions could for example include changes in inventory levels, capacity increases/decreases, or a restructuring between the different factories. Gained knowledge from previous plans and their outcomes should also be used. Issues that can't be resolved or issues that need a higher level of authority for decision making should be lifted to an appropriate level (part of next process step). The output of this process step should otherwise be an accepted consensus plan.

The sales and marketing department should, when there is a need for it, share information about the sales situation. Are customers, for example, launching bigger advertisements campaigns in the future that could influence the demand or if negotiations are held with potential new customers. In Table 3 below is a suggested meeting agenda presented, based on issues regarded as important for this process step.

Table 3. Example of meeting agenda

Meeting agenda
1. Present findings from the measurements done last process cycle (step 5) to evaluate forecast accuracy and highlight possible learnings
2. Present demand- and production plans with possible scenario analysis
3. Discuss identified gaps, issues and actions to take
4. Decisions to make: • What actions to take • If the plan can be accepted or not • What issues that need a higher level of authority
5. Sales/marketing present current sales situation

4. Implement the plan

Unresolved issues from the consensus meeting or decisions that need higher level of authority to be decided upon should be lifted to an executive meeting. This may for example include bigger investments or major changes in production capacity. When all matters are decided on a fully accepted plan should be

presented to affected people within the organization. In the case where the group that is meeting for the consensus plan has the authority to decide on these issues this doesn't has to be regarded as a separate step. This may be the case for smaller companies where both the consensus and executive meeting can be held at top-management level.

5. Measure the plan
As the last step in the process, measurements of the plan should be performed. It is crucial to make measurements in order to become aware of how accurate the developed plans are since important decisions are based upon them. This process step will give valuable input for all previous steps in the process. It is important to state that this process step not necessarily have to be a separate step in the sequential process. Some measurements may be preferable to perform within the first step (create initial demand plan), while others are more suitable for the second step (create initial production/supply plan). However, all measurements should be brought to the consensus meeting for decision support.

The most obvious metric to evaluate is the forecast accuracy (Lapide, 2004). As described in chapter 5.3, the FAI Analyzer tool should be used for the delivery plans sent from customers in order to evaluate both systematic errors and the magnitude of deviations for the most critical items, at single SKU level. This analysis is of special importance in the case where the company relies solely on the delivery plans from their customers for their demand plan. The result from this analysis should primarily be used in communication with customers in order to improve forecast quality. However, the output is also valuable for inventory level settings and what-if scenario simulations. Furthermore it is of great value to measure the forecast quality at a more aggregated level since measurement on an SKU level can indicate a very high level of deviation even though the total volumes within a group of products hasn't changed in any bigger sense. It is however important that appropriate product groups are identified. The product groups should be based on their capacity requirements, e.g. products going through the same line or cell. For this evaluation it is preferable to translate volumes to capacity units, e.g. hours, in order to be able to measure how much the forecasted capacity requirement fluctuates. This is important, since there is not necessarily a correlation between the volume and capacity requirements for products going through the same production unit. Hence, even though the total volumes within the product group doesn't change to any greater extent, the demanded capacity may differ a lot due to differences in capacity requirement for the individual items (or the other way around). For companies where the inbound material are of more critical importance for their delivery performance it is more suitable to group products in relation to what material the products consists of. For example, pipes consisting of stainless steel are one group and copper pipes are another group. This analysis should, as the FAI analysis, be made for monthly buckets and for time horizons equal to critical decision points (e.g. capacity increase/decrease). The result from this analysis will give a great understanding about the fluctuations in demanded capacity. For companies that create their own forecasts, forecast errors should also be continuously monitored. This should be done both at an SKU level but more importantly for product groups as described above.

Other operational KPIs connected to the S&OP process which are important to follow up on as well, are foremost inventory levels and capacity utilization and how well the planned levels matches the actual levels. In case of discrepancies an analysis of possible reasons should be performed.

Furthermore, in order to measure how well the plans are integrated it is also recommended to compare the planned demanded volumes with the actual produced volumes. Any possible discrepancies are important

to evaluate in order to identify the reasons for the deviations. For example, it may be the result of distrust from the production department regarding the demand plan, or just problems in production.

5.5.2 Suggestions of appropriate maturity level

If proposed guidelines stated in the previous chapter are implemented this will result in reaching maturity stage 3 for all framework maturity dimensions except for the organizational- and IT dimension. Implementing the consensus meeting in step 3 will increase the maturity for the dimension of meetings and collaboration as well as for S&OP plan integration to the third level. This due to formalized S&OP meetings and a higher level of plan integration where capacity utilization dynamics are considered in a greater extent. Further, applying continuously measures of forecast quality or quality of delivery plans will drive the measurement dimension to the third level of maturity. If a process owner is appointed for the S&OP process, which is regarded as a reasonable action when developing this type of process for companies with this specific context, this would result in reaching stage 3 on the organizational dimension as well. For the IT dimension, the third level includes having a S&OP dedicated software. As a first step, this is not considered as necessary for this type of companies, since focus should be to develop the actual process first (Lapide, 2004/2005). Spreadsheets may still be sufficient for most companies within this context. It is though important that these are consolidated and centralized for the different parties. For the companies with a high level of complexity regarding their product assortment, production sites and market segments, or for those who already are reaching a high level of maturity an investment in a S&OP dedicated software is more motivated. Based on this and the fact that current maturity level at the companies investigated, if roughly generalized, are at stage 2 it is reasonable to argue that aiming for reaching stage 3 for all dimensions (except for IT) is appropriate for these companies at present. As a first step, reaching this level of maturity will result in obvious gains for the companies. However, in the long run, the companies should always strive to continuously improve their process and thereby reach for the highest level of maturity within all dimensions. In Figure 27 below, the suggested gaps to be filled for the investigated companies are illustrated by the darker grey fields. Company G is omitted in this recommendation due to their already mature S&OP process. However, to continuously improve their process, the aim should be sat to reach the fifth level of maturity for all dimensions. From the argumentation above, all remaining companies are recommended to reach the third level of maturity in all dimensions except for IT. Company A, D and E are however in need of a more advanced IT system due to either the complexity of their planning activities or an already well developed S&OP process.

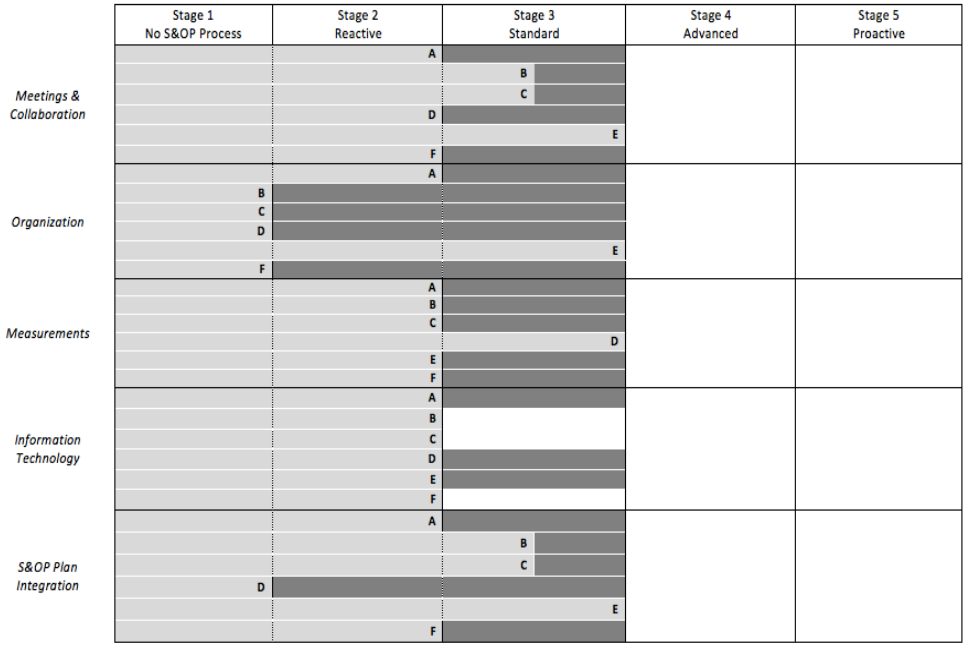


Figure 27. Suggested gaps to be filled

6. Recommendations

In this chapter, concise recommendations for how each step in the S&OP process can be performed is presented. These are formed from the analysis where deeper explanations and motivations for each recommendation can be found. Companies following these recommendations are believed to reach the third stage of S&OP maturity.

Organizational preparation

Why	Formalize S&OP process	
How	Appoint a process owner.	E.g. Logistics manager.
	Determine S&OP meeting participants.	Decide who from involved departments that should participate in the consensus meeting.
	Develop an S&OP calendar with meeting dates and deadlines.	
	Develop a meeting agenda.	See Table 3

Set planning parameters

Planning frequency	Monthly	
Planning horizon	Must cover longest lead-time for capacity changes or material acquisition, minimum 12 months.	
Planning object	Both SKU and aggregated level can be applied.	Product groups should be identified based on capacity requirements. E.g. products through a certain production cell/machine or products with the same ingoing material.

1. Create initial demand plan

Why Identify customers' demand

Who Sales/marketing

How

1. Download current order stock, consisting of delivery plans from customers.	
2. Aggregate order stock into monthly demand.	See Figure 25.
3. Identify the horizons of delivery plans.	See Figure 26
4. Measure and evaluate the delivery plans in order to identify for what time horizon they can be applied.	Not necessary to perform every process cycle.
5. Additional forecasting should be performed based on the outcome of the two previous recommendations (3 and 4) to cover the total planning horizon. Input to use for the additional forecast can be historical data, production programs and other additional information from customer.	
6. Create demand scenarios. Should be based on information from customer concerning possible demand increase/decrease not set in delivery plans as of yet or from forecast fluctuations discovered with FAI analysis.	
7. New product launches and products to be phased out should be considered and included in the demand plan.	

2. Create initial production/supply plan

Why Ensure production capacity and supply of material to meet the expected demand

Who Production/Procurement

How

1. Identify available capacity in production.	
2. Identify critical lead times for capacity increase/decrease regarding machinery and manning.	Lead times for installing new machinery/tools, hire/fire, change shift forms etc.
3. Identify lead-time for incoming material.	
4. Compare the demand plan with available production capacity and identify gaps.	
5. Reconcile material requirement with most important suppliers and identify possible material gaps.	
6. Perform what-if scenario analysis to review possible capacity and supply issues	Input from the demand scenarios

3. Create consensus delivery and production plan

Why Agree upon an operating plan

Who Representatives from: Sales/marketing, logistics, procurement, production, finance

How

1. Present findings from the measurements done last process cycle in order to evaluate forecast accuracy and highlight possible lessons learned.	
2. Present demand- and production plans with possible scenario analysis.	
3. Discuss identified gaps, issues and actions to take.	
4. Decide on which actions to take.	
5. Decide on a consensus plan and what/if that needs to be lifted to an executive meeting.	
6. Sales/marketing present current sales situation.	

4. Implement the plan

Why Accepting final operating plan

Who Executive/top-management group

How

1. Solve not yet resolved issues from the consensus meeting.	
2. Decide on final plan and what actions to take.	Important that the people who have the authority to make decisions are involved. Can be the same group as in the consensus meeting.
3. Communicate the plan to concerned parties and execute the plan.	

5. Measure the plan

Why Be aware of the quality of delivery plans/own forecasts

Who Appoint responsible

How

1. Preform FAI analysis to identify systematic errors, possible deviating patterns should be brought to customer.	Week-application should be used.
2. Preform FAI analysis to identify demand fluctuation for high-value items and items going through critical capacity points.	Time lags should be set to critical decision points. Month-application should be used.
3. Measure forecast quality for product groups.	Product groups should be based on capacity requirements. Volumes should be translated to capacity unit, e.g. hours or kg.
4. Evaluate inventory levels and compare with determined goals.	
5. Evaluate capacity utilization.	
6. Evaluate plan integration by measuring the difference between planned volumes and produced volumes.	
7. Bring the result from the measurement to next consensus meeting.	

7. Conclusions

This chapter concludes upon the major findings of this thesis and explains how the stated research questions are answered. It further contains propositions of areas for further research.

The automotive industry has, like other industries, suffered greatly from the economic downturn and it has become of even greater importance to reduce waste and become more efficient in order to survive. The participants of the project "Collaborative forecasting", initiated by Odette and NAF, identified the potentials of S&OP as an interesting area to explore for the automotive supplier context. Thus, the purpose of this thesis was to develop recommendations for how suppliers in the automotive industry should perform their S&OP process.

The main result of this thesis is concise recommendations for how companies within this specific context could develop and perform the S&OP process. The recommendations are structured around the five identified S&OP process steps with organizational preparation as an additional aspect. When developing the recommendations, both maturity and structure of the suppliers' current planning processes were taken into account. It is concluded from the analysis that the companies investigated generally have considerable gaps in their S&OP process structure if having a process at all. The steps including long-term capacity checks, cross-functional plan integration and measurement of forecast quality are regarded as the steps most problematic for these companies. The analysis further reveals that the S&OP maturity level at the companies is rather low. They are commonly regarded as non-users or reactive users, indicating that the awareness and existence of the S&OP process is limited. The majority of the investigated companies consequently suffer from issues that can be related to the lack of a long-term planning process. Issues mainly include difficulties of adjusting capacity to changes in demand in the matter of both personnel and equipment. The recommendations presented are believed to enable the companies to start closing the identified process gaps. Implementing the given recommendations will also result in a structured use of the FAI Analyzer tool, which today is used on a quite irregular basis when there is time or special need of such analysis. It is also suggested that the companies work towards reaching maturity stage 3, by implementing the suggested recommendations, which would make them standard S&OP users.

Furthermore is it concluded that the FAI tool can be applied for two main purposes in the S&OP process as the application is configured today. Firstly it can be used to identify systematic errors in delivery plans, which should be communicated to concerned customer in order to find possible root causes and improve forecast accuracy. Secondly it can be used to become aware of demand fluctuations, information appropriate to use as input for demand planning. It is also concluded that there is great potential for development of the FAI tool in order to better support the S&OP process than what the current version is able to today.

Circumstances specific for suppliers in the automotive industry were considered in the development of the recommendations. This includes the aspect of power imbalances between the OEM's and the smaller suppliers. Companies supplying to big automotive OEM's are very dependent on their customers for their own survival. In turn, the suppliers are obligated to fulfill the demands stated by the customers, without

being able to influence in the other direction. The existence of long-term delivery plans is also affecting the suppliers' planning activities within this type of industry. This transparency is in many cases very helpful for the suppliers since they can see the expected demand for a long-term future. However it is concluded that the forecast accuracy of the delivery plans on a long-term horizon can be considerably low and other input is therefore needed as a compliment. Furthermore, the S&OP literature usually suggest that the created demand plan can be adjusted with marketing activities and discounts in order to increase the demand for certain products. This can be a good strategy in order to get a more satisfactory utilization of the production. However, for suppliers within the automotive industry, this is not possible. The suppliers depend on what the customers demand for their final products, and it is obviously therefore not possible to promote any other components.

Considerable context differences within the reference group does influence the possibility to which degree the presented recommendations can and should be applied. How well developed the companies' current S&OP processes are will naturally affect different recommendations' relevance for each company. Some companies don't have an S&OP process at all today while others have parts of it. One other obvious aspect that separates the companies is their size and complexity. The smaller companies are to a greater extent getting away with not having a formalized process due to their natural communication between departments, which facilitates a higher level of plan integration. At the larger companies, having separate sites, communication between departments doesn't occur as naturally. The need of a formalized meeting procedure is thus greater. The size and complexity also affects the need of an IT solution supporting the planning activities. When the company complexity is low with fewer numbers of products, customers, etc. spreadsheets might be enough for managing the process. This can however become impossible for larger companies with greater complexity, where an IT solution may be needed. The production layout in relation to its' flexibility is also an aspect that influences the perceived need of a more formalized planning process. A high level of flexibility in production increases the possibility to adapt to changes in demand to a greater extent. Hence, the inaccuracy of plans will not influence the company's ability to deliver to the same degree, and the need of a more developed planning process is thereby not fully acknowledged.

7.1 Future studies

How to implement the developed process was not included in this thesis and this aspect is therefore suggested for future research. Implementation of an S&OP process is in literature pointed out as a difficult aspect to succeed with.

Moreover is it important to note that the investigated companies have different starting points and pre conditions for working with S&OP and should identify what parts of the recommendations that applies for them. For example the perceived need of an S&OP process widely varies from company to company. Size and the number of sites together with the production layout are identified as explaining factors. This is however an area that could be explored further and is also recommended for future research, i.e. how the planning context influence the possibilities for applying S&OP.

The difficulties of managing the demand for both new product launches as well as the demand for products being phased out has been mentioned as a problem for many of the investigated companies.

Even the companies with well-developed forecasting process are experiencing these kinds of difficulties. Limited research within this area does thereby motivate for future studies regarding how to handle this problem.

7.2 Trustworthiness

Since a multiple case study was carried out, investigating seven companies, the possibility to deeper look into and analyze each single company was limited. The empirical data is based on one initial interview with one or in some cases two or three representative from the company, most commonly the supply chain manager or similar. This might lead to a limited and one-sided view of the current state. If several interviews with representatives from various departments, influencing the S&OP process, had been conducted a more diverse and comprehensive picture would have been gained. However, the empirical data is strengthen by the fact that the findings was reconciled with the investigated companies through a follow-up phone call with the interviewee. The survey and the workshop did also offer the possibility to gather feed-back and discuss the findings even further. Since various participants from different types of companies participated in the workshop, the findings were discussed from different perspectives, which to some degree further increase the reliability of the results of this thesis.

7.3 Contribution of thesis

This thesis is regarded to contribute to both theory and practitioners mostly due to the specific context, the automotive industry that is investigated. There is limited literature on how the automotive context affects the possibilities of working with S&OP and what specific aspects that must be taken into account. These issues are through this thesis highlighted in the section above. The results of the thesis are also considered to be somewhat transferable to other companies. Due to the fact that it was a multiple case study and not a single case study further support this hypothesis since when several cases are studied the results are more general. For companies with the same context and similar preconditions, from an S&OP perspective, the developed S&OP recommendations are believed to be applicable to some degree.

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APPENDIX 1 – INTERVIEW TEMPLATE

General

Title:

- What is your title?
- Could you tell us short about your work and main tasks?

Company introduction:

Please shortly describe the company

- Size and location?
- Number of sites?
- Function of this site?
- Nationality?

Company Environment

Products:

- What kind of products do you produce? (Standard, low value, high value, etc.)
- How many SKU's in your process?
- How do you segment your products? (Families, models, single variants)
- Does the segments represents material requirements, capacity requirements etc.?
- How many SKU's within each family?

Market/demand

- How many customers do you have?
- Who are your customers? (OEMs, Tier 1, retail, wholesaler)
- Do you, and if so, how do you segment your customers? (e.g. geographically, how they buy, what they buy etc.)
- Could you describe your customer's behavior? How does it differ between segments/regions? (Changing orders, big orders, different delivery plans etc.)
- How long freeze time do you give your customers?

Process

- Do you manufacture all in-house? Is some process step outsourced?
- Do you Make to order, Make to stock?
- How long is a typical production run?
- Do all products follow the same process?
- What kind of process do you have? (Low, medium, high volume? Job shop, batch flow, assembly, continuous flow?)

Suppliers

- How many suppliers do you have?
- How do you segment your suppliers?
- How long lead time do you have from your suppliers?
- Could you describe your supplier's behavior? How does it differ between segments/regions? (Changing orders, late deliveries, right orders, etc.)

Planning questions

Do you have separate planning processes (S&OP, Master production Scheduling)?
Is there a process owner for the planning process?

S&OP questions

1. Please describe your process of forecast future demand:
   - Bottoms up/top down mixture?
   - Who is involved? Which organizational levels?
   - What forecasting methods do you use? (Qualitative, quantitative)
   - Time frame: 3/6/12/18 months? Other?
   - What is the planning object? (Product families, single SKU)
   - How long planning buckets? (Day, week month?)
   - How long time does it take to generate a forecast?
   - How often are the forecasts generated and updated?
   - What tools do you use? Spreadsheet/more sophisticated software?
   - Do you involve your customers?
   - What factors do you base your forecast on? (Historical data, customer forecast, economic climate, etc.)
   - Do you use forecasts from your customers? If so, how?

2. Please describe your process for supply or operations planning:
   - Who is involved?
   - Are any of your suppliers involved? (Present at meetings, data input?)
   - What inputs do you use from demand forecasts? (Input from elsewhere as well?)
   - Who sees the operations plans when complete? Sales/marketing?
   - Is capacity utilization considered when creating the production plan?
   - How long planning buckets?(day, week month?)

3. Please describe how you integrate the demand and supply plans:
   - Do you have meetings with both supply and demand side personnel?
   - Who else is involved? (Finance, production, logistics, suppliers, customers, etc.)
   - If so, how often?
   - Is there pre-work for each meeting?
   - Is there a formal meeting structure? If so please describe
   - What time frame does the S&OP focus on?
     - 0-3 months
     - 3-6 months
     - 6-18 months
   - A combination of above or other?

4. What IT structure is used for demand, supply and S&OP planning?
   - Spreadsheets - is there a single one or several? Is the information shared between departments?
   - Is there any specific software that you use?
   - Are the demand and supply side systems linked?

- What ERP system do you use?
- Scenario simulation and analysis?
- Centralized information? (Accessible to everyone)

5. What measurements do you use to evaluate the S&OP effectiveness?
   - Financial: cash flow, revenue, costs?
   - Operational: inventory turns, capacity utilization?
   - Marketing: forecast accuracy?
   - How often do you fail to deliver to your customers? On-time deliveries?
   - How often are you forced to take actions in order to avoid late deliveries? (Overtime in production, express deliveries etc.)
   - How much tied capital do you have in stock? Is this an appropriate level?
   - Anything else that you think is a consequence of bad planning?

6. How do you respond to disruptions to your demand forecast?

7. How do you respond to disruptions in operations?

8. Meetings:
   - Collaboration tools - videoconference, physical presence, web tools?
   - Repetitive scheduled meetings? Or event-driven?

9. Organization:
   - Are the S&OP concept known and understood within the company?
   - DO you have an S&OP coordinator? Full or part time? Who does he/she report to?
   - DO you have an S&OP team - how many, full or part time, departments represented?
   - Who from senior management is involved and how?

10. Do you see any problems/issues with the current S&OP/planning process? Any benefits that haven't been obtained that you were expecting?

11. Can you see any internal constraints that affect your company's way of working with S&OP? Are there any that are specific for you?

12. Can you see any benefits with having a longer planning horizon (1,5-2 years)?

FAI

13. How much have you used the FAI tool?
    - What benefits do you see with the tool?
    - What have you used the tool for?
    - Who have used the tool?
    - What data have you used? (Customers delivery plans, own forecasts)
    - What parameters have you used? (Aggregated product, single products, time horizon?)
    - Have you taken some actions against problems you discovered by the tool? (Problems with specific SKUs etc.)
    - What do you think should be the main use for the tool?

14. Configurations
    - Lag times? (Where is your key decision points in long term, e.g. material purchase, capacity increase)
    - Weighting factors? (Which key decision points is the most important?)

APPENDIX 2 – INTERVIEWEES

Company	Title
Company A	Vice president logistics
Company B	IT and Logistics manager
	Production planner
Company C	Logistics manager
Company D	Operational Manager
Company E	Logistics manager
Company F	Logistics manager
	Purchaser
	Key account manager
	Production Planner
Company G	Manager Manufacturing Supply Planning

APPENDIX 3 – FAI CALCULATION EXAMPLE

Below, a simple FAI calculation example is illustrated. In the example, a customer provides forecasts once a month and the analysis is made by comparing the actual volume taken in January and the forecasts for the previous four months, which then represents the lag points. The weighting factors in this case are each set to 0.25, i.e. all forecasts are perceived to be equally important.

	Forecasts for January				Actual
Month of forecast	Sept	Oct	Nov	Dec	Jan
	Lag 1	Lag 2	Lag 3	Lag 4	
Quantity	7000	5100	2780	3400	**3400**
Weighting factor (must add up to 1)	0.25	0.25	0.25	0.25	1.00
Deviation from actual	3600	1700	-620	0	
Absolute deviation (remove sign)	3600	1700	620	0	
Relative absolute deviation = Absolute deviation/Actual	1.059	0.500	0.182	0.000	
1 - (Relative Absolute Deviation)	-0.059	0.500	0.818	1.000	
1 - (Relative Absolute Deviation) **excluding any negatives**	0.000	0.500	0.818	1.000	

FAI = **∑ (Weighting factor x (1-Relative Absolute Deviation)) / 100**

= ((0.25 x 0.0) + (0.25 x 0.5) + (0.25 x 0.818) + (0.25 x 1.0)) / 100

= **57.95%**

$$\textbf{WTS} = \frac{\sum \text{(Weighting factor x Deviation)}}{\sum \text{(Weighting factor x Absolute Deviation)}}$$

$$= \frac{((0.25 \times 3600) + (0.25 \times 1700) + (0.25 \times -620) + (0.25 \times 0))}{((0.25 \times 3600) + (0.25 \times 1700) + (0.25 \times 620) + (0.25 \times 0))}$$

= **0.79**

+1 = all forecasts are positive
0 = all forecasts are correct
-1 = all forecasts are negative

APPENDIX 4 –NAF/ODETTE PROJECT PARTICIPANTS

Name:	Title:
Johan Bystedt	FAI Project Manager
Johan Cervell	FAI Application Developer
Johanna Andersson	FAI Installation Coordination
Maja Weber	FAI Analyzing
Sten Lindgren	CEO Odette Sweden
Victor Daniel	Process Owner Material Control
Henry Rosten	Head of Volume & Capacity
Kivi Antti	Volume & Supply Manager
Klas Holmér	Forecasting Engineer
Helena Eriksson	Supply Chain Performance and Process Management
Luc Graux	Director Automotive Division
Vikram Pimpalkhare	Demand Chain process manager
Mats Petersson	Manager fulfill and demand ERP
Ulf Andersson	S&OP Process Owner
Harald Holtsung	Process Analyst
Henrik Svennberg	Vice President Logistics
Daniel Söderman	Logistics Manager
Esa Kuosko	IT Manager
Thor Köhler	Operational Manager
Yulianto Blom	Logistics Manager
Ola Karlsson	Logistics Manager
Niklas Johansson	Logistics Manager
Fredrik Wärn	Logistics Manager
Emilia Hjortenholt	Purchases
Kjell Jonsson	Production Planner
Zander Josefsson	Account Manager
Mikael Ryling	Logistics Manager
Helena Eriksson	Logistics Manager
Erik Petersson	IT & Logistics Manager
Rickard Holm	Sr Manager Projects
Hans Jörgen Abrahamsson	Logistics Manager

APPENDIX 5 – WORKSHOP SURVEY

Following statements was handed out to the suppliers before the workshop, where they could answer true or false or no opinion to each question.

Demand/Delivery Plan

- We see difficulties with developing forecasts with a long-term horizon (1-2 years).
- We do manual adjustments of the delivery plans that are sent from our customers.
- For some products it is relevant to investigate statistical sales history when developing a forecast
- The FAI analyzer tool is suitable for finding patterns in the delivery plans and make manual adjustment based on these.
- The delivery plans from our customers are good enough to base decisions on capacity and supply plans from.
- The FAI analyzer tool is suitable to use internally in order to adjust inventory levels.

Production/Supply Plan

- Supply of material is the most critical for out delivery performance.
- Capacity in production is the most critical for out delivery performance.
- To have a planning horizon of 1-2 years would ease the long-term estimation of capacity requirements.
- We find it difficult to acquire and install new machinery in production before it is needed due to short-term planning horizon.
- We find it difficult to hire and train new employees before it is needed due to short-term planning horizon.
- Problems regarding material availability often arise due to long lead-time from our suppliers.
- We have to bring in additional staff or add extra shifts due to changed plans more often than we would like.
- Capacity utilization in the production is at a satisfactory level.

Consensus Plan

- Sales/ marketing and production department works separately and communicates only when problems arise.
- It is important that top-management takes part of the sales and production plans.
- It would be desirable to have meetings concerning sales and production plans with representatives from the following departments:
    - Marketing/Sales
    - Production
    - Procurement
    - Logistics
    - Financial
    - Product development
    - Other

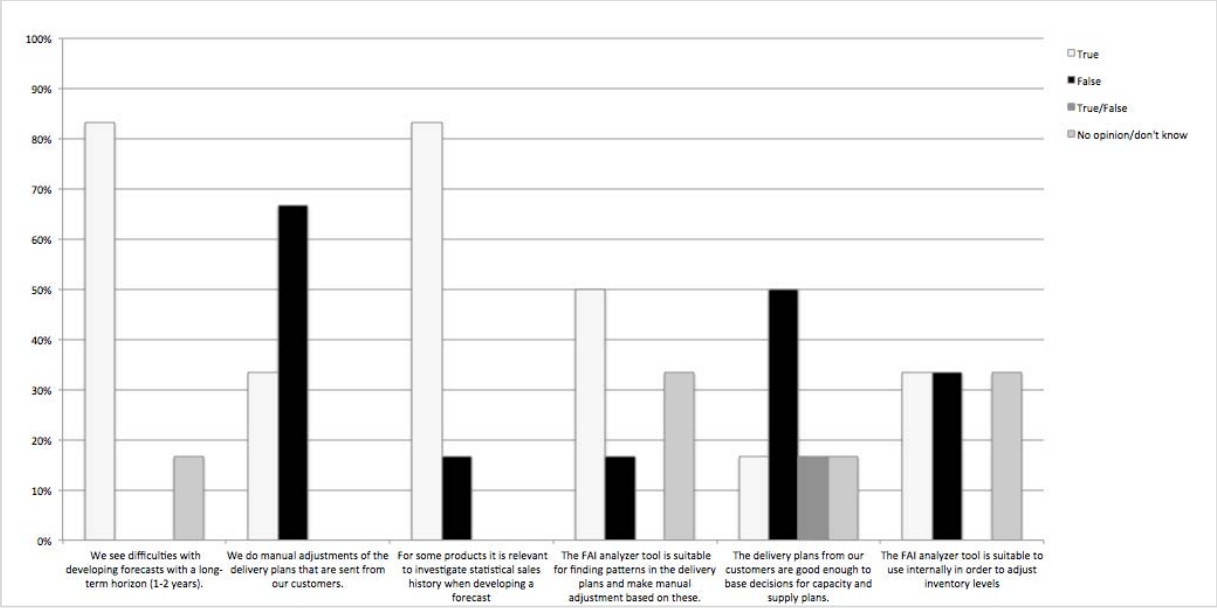
Measurements

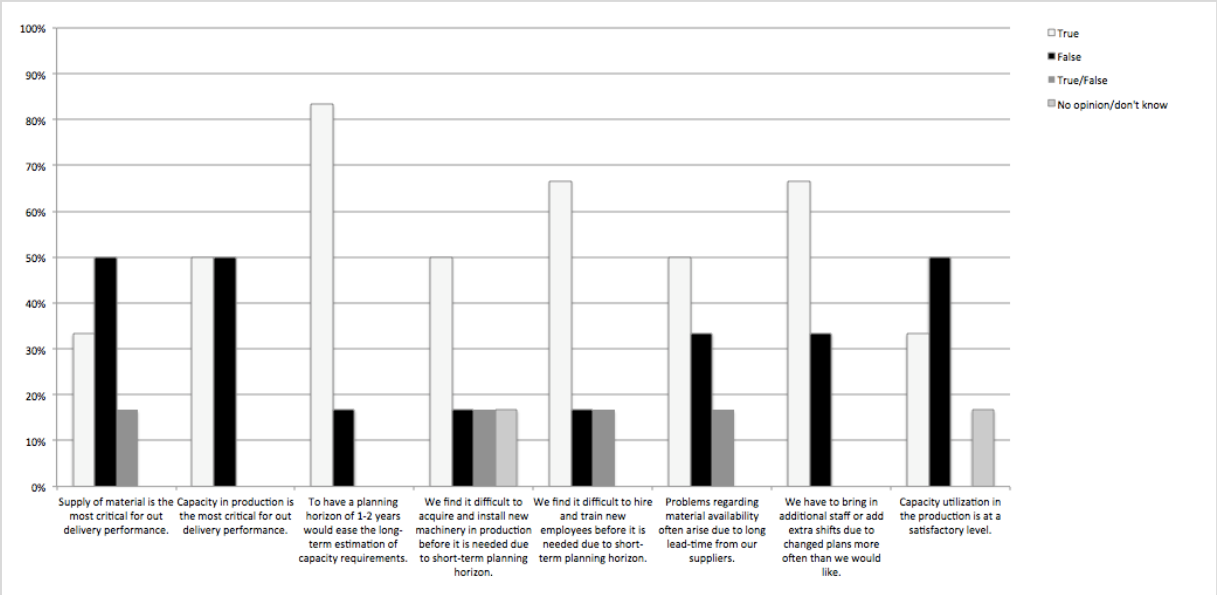
- Forecast quality / quality of delivery plans is continuously measured.
- It is important to measure the forecast accuracy.
- High levels of tied-up capital in our inventories are a problem we have.
- Our stock holding costs are considered too high.
- We have good delivery performance to our customers.

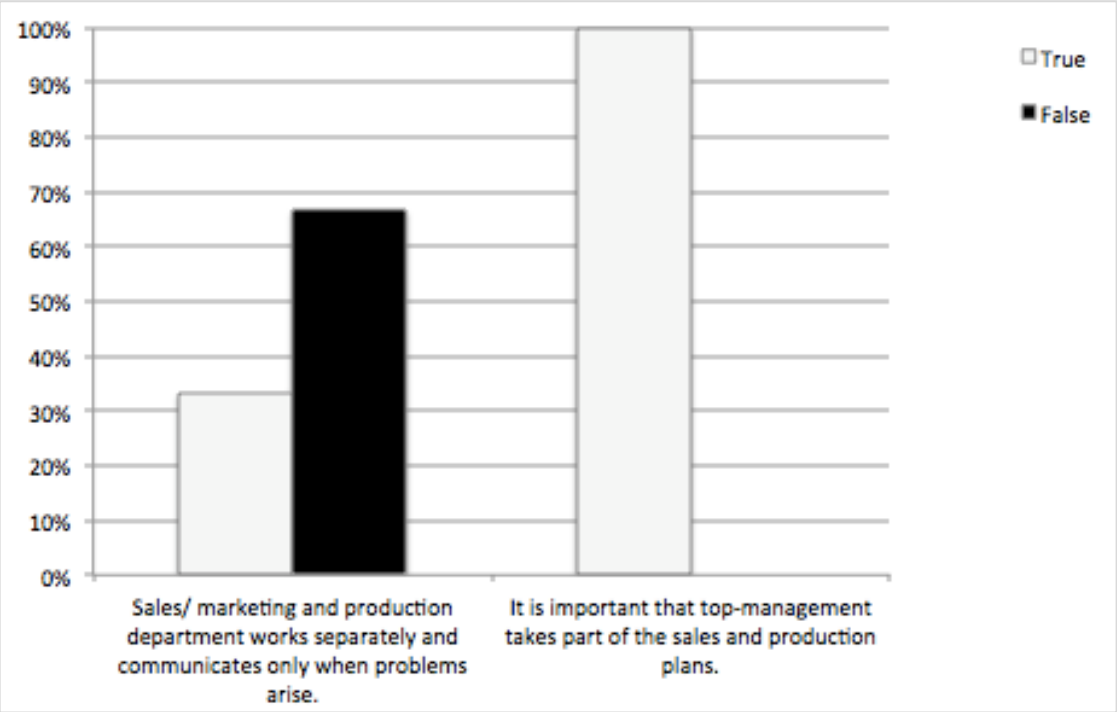
FAI Analyzer Tool

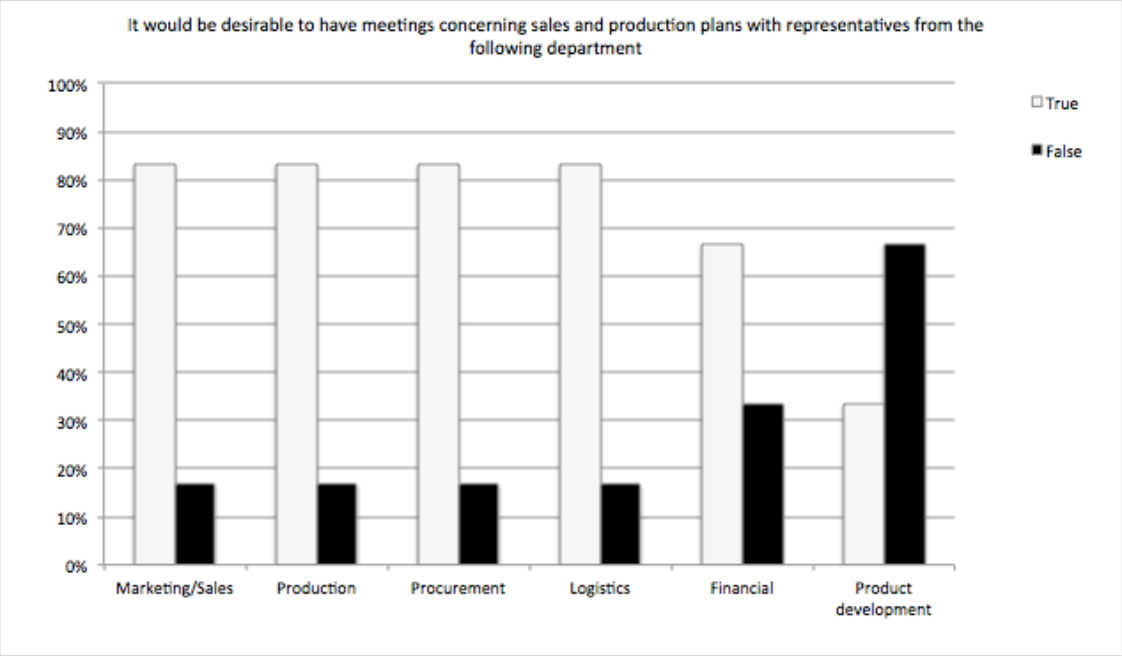
- We have continued to work with FAI analyzer tool in order to analyze the forecast accuracy.
- We use the FAI analyzer tool primarily for internal purposes.
- We use FAI tool primarily for communication with customers / suppliers.
- We have found patterns in the delivery plans in the FAI analyzer tool and taken action accordingly.
- FAI analyzer tool has been presented and used by more people in the company.

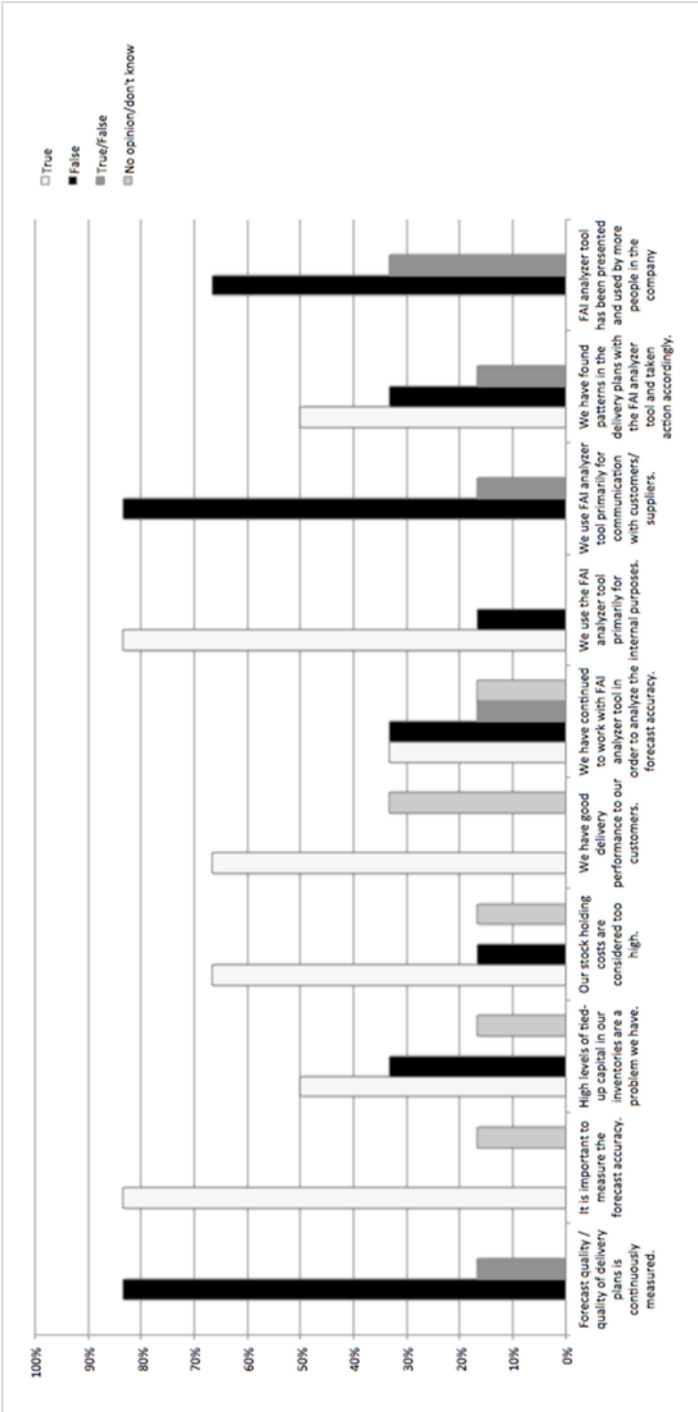
APPENDIX 6 – WORKSHOP SURVEY RESULTS






100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
True
False
Sales/ marketing and production department works separately and communicates only when problems arise.
It is important that top-management takes part of the sales and production plans.


It would be desirable to have meetings concerning sales and production plans with representatives from the following department
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
True
False
Marketing/Sales
Production
Procurement
Logistics
Financial
Product development



True
False
True/False
No opinion/don't know
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Forecast quality / quality of delivery plans is continuously measured.
It is important to measure the forecast accuracy.
High levels of tied-up capital in our inventories are a problem we have.
Our stock holding costs are considered too high.
We have good delivery performance to our customers.
We have continued to work with FAI analyzer tool in order to analyze the forecast accuracy.
We use the FAI analyzer tool primarily for internal purposes.
We use FAI analyzer tool primarily for communication with customers/ suppliers.
We have found patterns in the delivery plans with the FAI analyzer tool and taken action accordingly.
FAI analyzer tool has been presented and used by more people in the company

APPENDIX 7 – FAI ANALYZER TOOL DEVELOPMENT SUGGESTIONS

Due to the fact that the FAI Analyzer tool is an open application where there is room for adjustments some possible development suggestions are given in order to better support the S&OP process. By definition FAI gives the forecast accuracy in absolute value. This is also an important measure, especially for communication with customers when deviating patterns in delivery plans are identified, but there are more potential for the S&OP process support if the application is further developed. The idea is to use the same input that is used in the FAI tool today, the delivery plans, but to analyze the data for internal planning purposes to a greater extent. Two new tabs are suggested to be added to the application. The new tabs will be "Forecasts" and "Demand/Production plan".

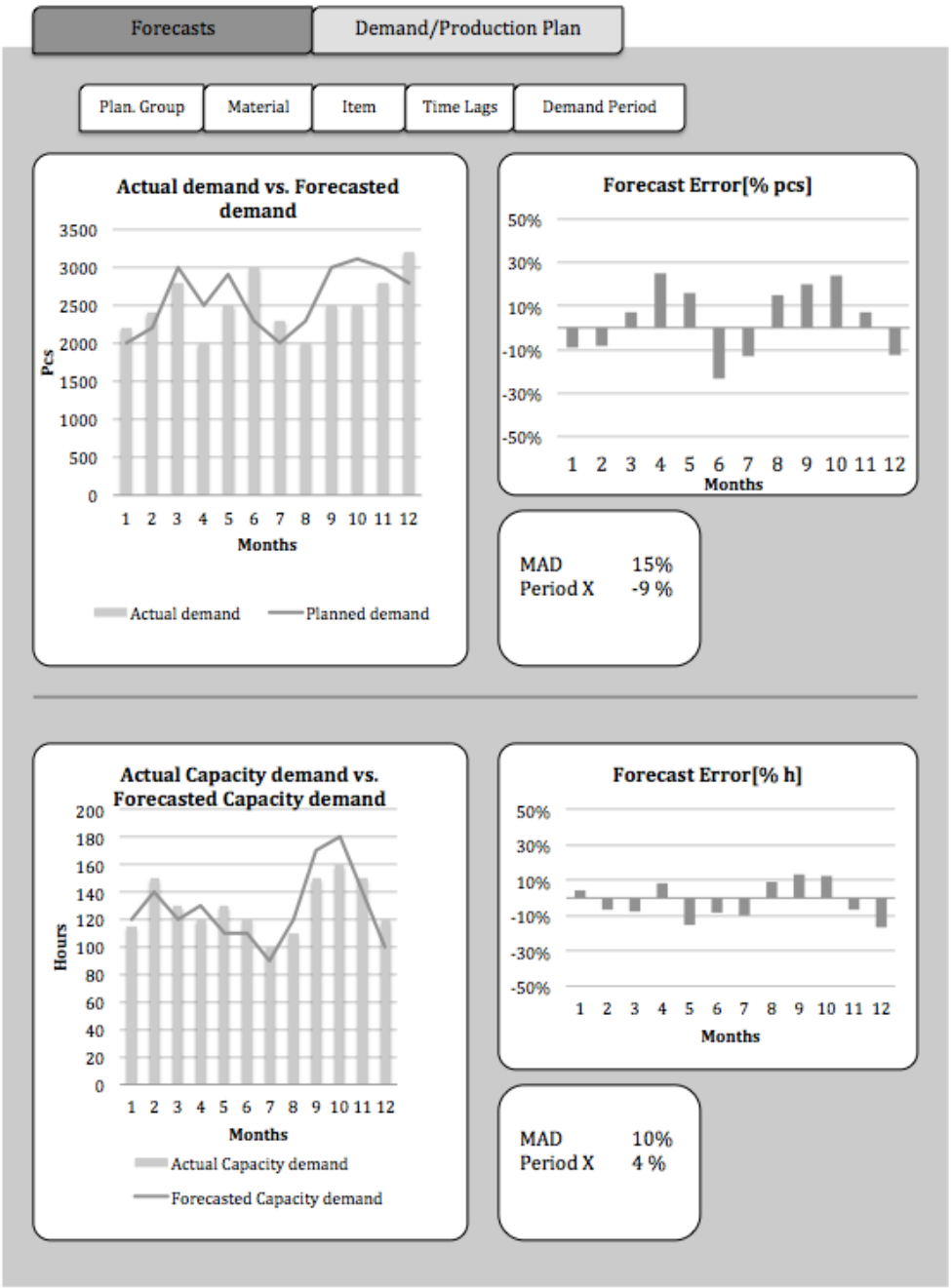
Forecasts

The purpose with the forecasting tab is to be able to compare forecasted demand with actual demand, with regard to capacity requirement. This tab is quite similar to the FAI Analyzer tool, as it is structured today. However, the purpose of this tab is to measure the quality of the forecasts/delivery plans in order to identify how flexible the company has to be regarding their production and supply capacity. Due to this, the selection categories are suggested to be changed from "Partner", "Address", "Item" and "Demand Period" to "Plan. Group", "Material", "Item" and "Demand Period". One further aspect that is important is how the aggregated forecast error metric is calculated. As of today, FAI on an aggregated level is calculated as a mean value from the absolute deviation of the items belonging to the chosen group. However, when calculating the error of forecasted required capacity it is more suitable to sum up the total capacity requirement for the group of items and compare with the total capacity requirement for the actual demanded volumes, i.e. firm orders. The reason for this is that the absolute deviation for each item may differ significantly but the total amount of required capacity can still be similar to what was expected. This should be applied both for the selection of material and planning group.

In the case where a selection is made for material, the items consisting of the chosen material will be grouped together and the deviations will be calculated in number of pieces, or other suitable capacity units such as kilograms or meters. The selection of planning groups will then no longer be possible since there is no correlation between those two choices.

The possibility to group the items with regard to what planning group they belong to will give a better idea of how big the variances in capacity requirements are. One requirement for this selection is also to implement hours as a unit in the tool, and thereby measure the amount of time required to produce the forecasted demand for a certain planning group. This requirement should then be compared with the actual time required, from the volumes demanded, which is represented as the reference value in the FAI Analyzer tool today. Using hours as unit, instead of volumes that is used today, will result in a better understanding about the production capacity requirements since the capacity requirements may vary for different items. This analysis is most important to perform for bottlenecks or critical planning groups where problems may arise.

The Forecasts tab is illustrated below, in the upper section the actual demand compared with the forecasted demand in pieces is shown, as well as the deviation in percentages. The time lags, i.e. for which month the reference demand should be compared with, can be set as in the FAI Analyzer tool. Further is the mean absolute deviation (MAD) for the whole year shown together with the forecast error for a selected demand period X. In the lower section, the actual capacity demand compared with the forecasted capacity demand in hours and the deviation in percentages is illustrated. The MAD and forecast error for a chosen demand period is also shown.

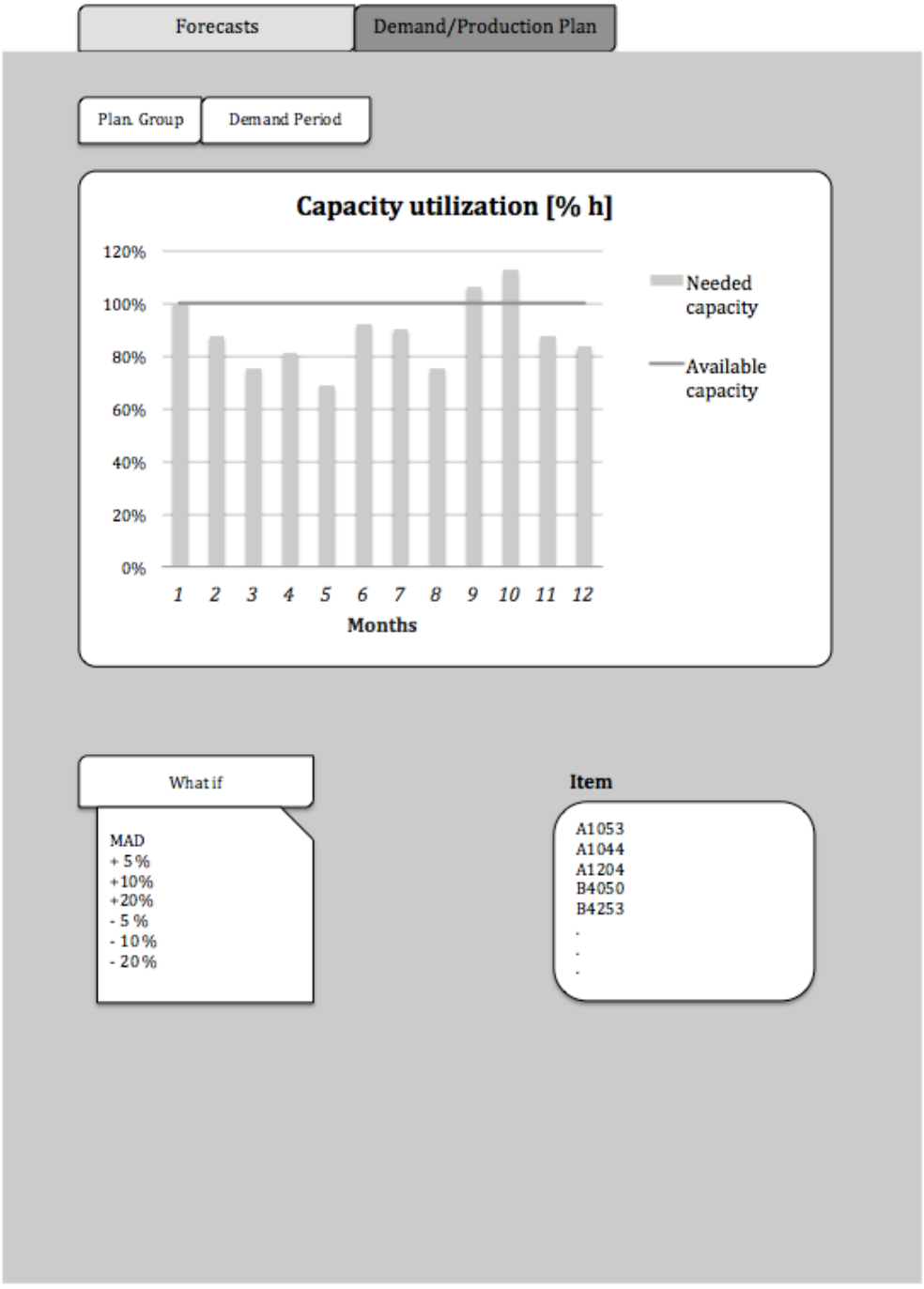


Demand/Production Plan

The second step in the S&OP process, i.e. create an initial supply/production plan, has been identified as a weak spot at many of the investigated companies. Capacity evaluation is an important part of this step in order to identify possible gaps in capacity that could constitute a potential risk for the company, not being able to produce what have been promised to the customers, and might require action. Especially for the long run, this important part is lacking to a great extent at most companies investigated.

This tab should include the selection categories of “Planning group” and “Demand Period” and should illustrate the comparison between next coming 12 months’ capacity requirements with available capacity for the chosen planning group. This tab is also suggested to contain a basic what-if scenario analysis option. Here it should be possible to simulate different volume increases/decreases from standard values, but also from the deviations identified in the “Forecasts” tab. The information found in this tool will be of great value for the consensus meeting.

The tab can be seen below where the capacity utilization for the next coming 12 months for a certain planning group is illustrated. In the bottom left different demand scenarios can be chosen. In the bottom right the items belonging to that certain planning group is listed.


Forecasts
Demand/Production Plan
Plan. Group
Demand Period
Capacity utilization [% h]
120%
100%
80%
60%
40%
20%
0%
1 2 3 4 5 6 7 8 9 10 11 12
Months
Needed capacity
Available capacity
What if
MAD
+ 5 %
+10%
+20%
- 5 %
- 10 %
- 20 %
Item
A1053
A1044
A1204
B4050
B4253
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