Sales and operations planning in the process industry – A diagnostic model

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Abstract

Increased competition and globalisation has created new opportunities and challenges for supply chain planning. Implementation of sales and operations planning (S&OP) has thus become vital for companies in order to keep up with competition. One way of facilitating the implementation and assessing the current state of an S&OP process is by the use of maturity models.

The purpose of this study is to; (1) evaluate S&OP maturity models through comparative analysis and application on a company in the process industry, (2) develop a maturity model suitable for the process industry, (3) suggest a method for using it, and (4) add to the limited number of case studies describing the S&OP process of companies in different industries.

The study has been conducted using a qualitative case study methodology. Qualitative data has been collected through semi-structured interviews with 19 employees from different levels and functions of the organisation in order to develop a complete picture of the S&OP process at the case company.

The evaluation of current S&OP maturity models in a case study context has generated a maturity model suitable for the process industry and a qualitative method for maturity assessment. The assessment has also resulted in an in-depth analysis and description of the S&OP process of a company in the pulp and paper industry.
Acknowledgement

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1. Introduction

In this first chapter, a background to the paper is provided, followed by a presentation of the study purpose along with the research questions that are to be answered. The chapter ends with a short presentation of the structure of the remainder of the paper.

1.1 Background

Increased competition and globalisation has created new opportunities and challenges for supply chain planning (Raman and Watson, 2004). The increasing complexity of markets, supply structures and investors make management of supply chain integration more complex and important than ever (Olivia and Watson, 2010). Sales and operations planning, S&OP, is used to integrate different business plans with the main purpose to balance supply and demand and to integrate the strategic and operational plans of the business (Thomé, et al., 2012).

S&OP is an area of growing interest among researchers and recently several maturity models have been developed (Thomé, et al., 2012). The maturity models are used to assess the current state of an S&OP process and to identify appropriate actions to take in order to improve it (Grimson and Pyke, 2007; Lapide, 2005). Despite the growing interest in S&OP among researchers, little attention has been paid to its implications on different industries as S&OP has been treated mainly as a generic process, without consideration to different industry characteristics (Noroozi and Wikner, 2014). Process industries have specific characteristics and often employ process flow production and a level planning strategy, differentiating their planning approaches from those of other industries (Noroozi and Wikner, 2014; Olhager, 2001; Fransoo and Rutten, 1994). A large proportion of the Swedish process industry is comprised of the pulp and paper industry which is vital for the Swedish economy (The Swedish Forest Industries Federation, 2014a).

In 2012 two companies in the Swedish pulp and paper industry merged to one. The newly formed company is one of the largest producers of fibre-based packaging material in Sweden, and aims to implement a companywide S&OP process. As of today, there is no coherent process within the company and planning is done in different ways at different levels depending on their historical organisational inherency.

A prerequisite for a successful S&OP implementation, and to determine appropriate actions, is to identify and assess the current state of the S&OP process (Lapide, 2005). Finding an eligible maturity model is therefore a key component for relevant S&OP improvements. There are currently no maturity models adapted specifically for the process industry. Further on, essentially no evaluations of the existing maturity models, nor methods or procedures for using them can be
found in the S&OP literature.

It would consequently be of great interest and value to examine how S&OP assessment in the economically important process industry differs from other industries, and to investigate to what extent existing maturity models are applicable to process industry companies. Particularly as there could be great gains of a well-developed S&OP process in the capital-intensive process industry (Fransoo, 1992).

1.2 Purpose

The purpose of this study is therefore to; (1) evaluate S&OP maturity models through comparative analysis and application on a company in the process industry, (2) develop a maturity model suitable for the process industry and (3) suggest a method for using it.

In addition, despite the growing interest for S&OP among researchers there is still an expressed lack of case studies within the field of research describing the S&OP process in different industries and cultures, as well as for empirical data from in-depth interviews with managers and stakeholders in the supply chain (Thomé et al., 2012). Therefore, this study will (4) add to the sparse pool of case studies within the field and contribute to filling the identified gap.

1.3 Research questions

In order to fulfill the research purpose this study will attempt to answer the following research questions:

I. What is a suitable maturity model for evaluating the maturity level of the S&OP process of a company in the process industry?

II. What is a qualitative process for a successful maturity level assessment?

On account of the case company, who has requested recommendations for improving their current S&OP process, an additional research question will be answered:

III. What recommendations should be given to the case company based on the current level of maturity of its S&OP process?

Although the main reason for including this research question is to fulfill case company requirements, it will also provide theories to be used in the process industry specific maturity model, as recommendations and appropriate actions are to be identified using the model.
1.4 Structure of the remainder of the report

The remainder of this report is divided into seven parts. First off, the industry and case company are briefly described to establish the case context. This is followed by a literature review, where key parameters of S&OP are identified and explained along with a presentation of a theoretical framework. Thereafter, in the methodology chapter, the research paradigm is identified, the choice of methodology and methods are justified, and the limitations of the research design are addressed. This is followed by the results and analysis chapter, in which the interview findings are presented and analysed. The paper ends with a conclusion chapter, which summarises the study and its limitations, and proposes suggestions for future research.
2. Industry and Case Company

The following sections contain introductions to the characteristics of the process industry as well as the pulp and paper industry, followed by descriptions of the case company’s different business areas and their corresponding market outlooks.

2.1. Process industry

The pulp and paper industry is a process industry, which is characterized by high volume, low variety products and inflexible processes (Abdulmalek et al., 2006). The American Production and Inventory Control Society, APICS, defines process manufacturing as “production that adds value by mixing, separating, forming, and/or performing chemical reactions. It may be done in either batch or continuous mode” (APICS dictionary, 2013a).

Likewise, process flow production is defined as: “A production approach with minimal interruptions in the actual processing in any one production run or between production runs of similar products. Queue time is virtually eliminated by integrating the movement of the product into the actual operation of the resource performing the work” (APICS dictionary, 2013b).

All process industries employ process manufacturing, but all do not employ flow production techniques (Abdulmalek et al., 2006). Fransoo (1992) argues that paper production is a flow process industry. Similarly, Taylor and Bolander (1995) state that the paper industry applies flow processes. This notion is supported by Abdulmalek et al. (2006), who state that paper industries tend to have a high product volume, naturally making the processes flow continuously.

Fransoo and Rutten (1994) argue that if large product quantities are demanded, continuous (flow) production is justified, but if demand is lower, batch production is preferred and that the paper industry tends to lean towards the flow production side of the continuum (see figure 1 below). Characteristics of the different production types according to Fransoo and Rutten (1994) are presented in table 1 below. The case company in this study is a producer of fibre-based packaging material and has characteristics from both sides off table 1, which is consistent with the view of Fransoo and Rutten (1994) (see section 2.3 for more information about the case company).
### Table 1. Characteristics of flow and batch production in the process industry (Fransoo and Rutten, 1994)

<table>
<thead>
<tr>
<th>Process/flow businesses are characterized by</th>
<th>Batch/mix businesses are characterized by</th>
</tr>
</thead>
<tbody>
<tr>
<td>• High production speed, short throughput time</td>
<td>• Long lead time, much work in process</td>
</tr>
<tr>
<td>• Clear determination of capacity, one routing for all products, no volume flexibility</td>
<td>• Capacity is not well-defined (different configurations, complex routings)</td>
</tr>
<tr>
<td>• Low product complexity</td>
<td>• More complex products</td>
</tr>
<tr>
<td>• Low added value</td>
<td>• High added value</td>
</tr>
<tr>
<td>• Strong impact of changeover times</td>
<td>• Less impact of changeover times</td>
</tr>
<tr>
<td>• Small number of production steps</td>
<td>• Large number of production/process steps</td>
</tr>
<tr>
<td>• Limited number of products</td>
<td>• Large number of products</td>
</tr>
</tbody>
</table>

### Figure 1. The one-dimensional typology for process industries of Fransoo and Rutten (1994)

Starting up and shutting down production in process industries is often costly, and scheduling capacity therefore often precedes the scheduling of materials in the annual production planning (De Matta and Miller, 1996). Carlsson et al. (2009) describe the capacity utilisation in the paper industry as overall very high (91 per cent) and that production runs continuously except during regular maintenance stops. This notion is supported by the interview respondents at the case company who state that the production units have yearly planned maintenance stops (I1; I12; I15; I17, 2014). Similarly Olhager et al. (2001) argue that a level planning strategy is often implemented in the process industry; leading to a stable machine capacity utilisation and that change in demand has to be absorbed by changes in inventory levels or changes in order backlog.

### 2.2. Pulp and paper industry

The pulp and paper industry is important for the Swedish economy. Sweden is the second largest producer of pulp and paper in Europe (The Swedish Forest Industries Federation, 2014a) and the industry as a whole accounts for approximately six per cent of the Swedish industry export (The Swedish Forest Industries Federation, 2014a; 2014b).

The Swedish Forest Industries Federation uses eight different categories to classify the produced
paper; newsprint, mechanical print, wood free print, tissue, wrapping paper, corrugated material, paperboard for packaging, and other paper and paperboard (The Swedish Forest Industries Federation, 2014a). The production of newsprint, wood free print has decreased during the last 5-8 years, whereas the production of corrugated material has been quite stable over the same period, further on, the production of mechanical print, tissue, wrapping paper and paperboard has increased over the same period (The Swedish Forest Industries Federation, 2014a). Development of the production for the period 2005-2013 is shown in table 2 below.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Newsprint</td>
<td>2 572</td>
<td>2 541</td>
<td>2 547</td>
<td>2 560</td>
<td>2 405</td>
<td>2 167</td>
<td>2 120</td>
<td>2 013</td>
<td>1 558</td>
</tr>
<tr>
<td>Mechanical printing paper</td>
<td>1 508</td>
<td>1 823</td>
<td>1 788</td>
<td>1 881</td>
<td>1 533</td>
<td>2 019</td>
<td>2 088</td>
<td>2 057</td>
<td>1 975</td>
</tr>
<tr>
<td>Woodfree printing paper</td>
<td>1 611</td>
<td>1 590</td>
<td>1 546</td>
<td>1 383</td>
<td>1 273</td>
<td>1 302</td>
<td>1 281</td>
<td>1 377</td>
<td>1 303</td>
</tr>
<tr>
<td>Tissue paper</td>
<td>317</td>
<td>317</td>
<td>319</td>
<td>330</td>
<td>338</td>
<td>350</td>
<td>352</td>
<td>361</td>
<td>353</td>
</tr>
<tr>
<td>Wrapping paper</td>
<td>956</td>
<td>1 008</td>
<td>1 018</td>
<td>925</td>
<td>999</td>
<td>1 047</td>
<td>1 013</td>
<td>1 006</td>
<td>972</td>
</tr>
<tr>
<td>- sack paper</td>
<td>510</td>
<td>565</td>
<td>579</td>
<td>499</td>
<td>560</td>
<td>576</td>
<td>552</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Corrugated material</td>
<td>2 197</td>
<td>2 154</td>
<td>2 058</td>
<td>2 007</td>
<td>1 892</td>
<td>1 902</td>
<td>1 833</td>
<td>1 914</td>
<td>1 933</td>
</tr>
<tr>
<td>- Kraftliner</td>
<td>1 593</td>
<td>1 567</td>
<td>1 536</td>
<td>1 505</td>
<td>1 414</td>
<td>1 418</td>
<td>1 321</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Paperboard for packaging</td>
<td>2 455</td>
<td>2 498</td>
<td>2 464</td>
<td>2 469</td>
<td>2 376</td>
<td>2 511</td>
<td>2 569</td>
<td>2 630</td>
<td>2 636</td>
</tr>
<tr>
<td>Other paper and paperboard</td>
<td>159</td>
<td>135</td>
<td>120</td>
<td>121</td>
<td>117</td>
<td>99</td>
<td>64</td>
<td>59</td>
<td>52</td>
</tr>
<tr>
<td>Total paper and paperboard</td>
<td>11 755</td>
<td>12 066</td>
<td>11 860</td>
<td>11 676</td>
<td>10 933</td>
<td>11 397</td>
<td>11 321</td>
<td>11 417</td>
<td>10 782</td>
</tr>
</tbody>
</table>

2.3 The case company

The case company is a world-leading manufacturer of fibre-based packaging material with customers in over 100 countries (The case company website, 2014). It was founded following the merger of company X and company Y in November 2012 when company X acquired all shares in company Y (The case company website, 2014).

Figure 2 below illustrates the historic mergers and acquisitions leading up to the formation of the case company in 2012.
The business of the case company is divided into three business areas: Business area 1 mainly corresponding to wrapping paper, business area 2 corresponding to paperboard for packaging and business area 3 mainly corresponding to corrugated material. The production is carried out at eight production units.

Table 3. Sales volumes, business areas and segments (The case company website, 2014)

<table>
<thead>
<tr>
<th>Business Area</th>
<th>Per cent of sales volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business area 1</td>
<td>42%</td>
</tr>
<tr>
<td>- Segment 1</td>
<td>17%</td>
</tr>
<tr>
<td>- Segment 2</td>
<td>12%</td>
</tr>
<tr>
<td>- Market pulp</td>
<td>13%</td>
</tr>
<tr>
<td>Business area 2</td>
<td>37%</td>
</tr>
<tr>
<td>- Segment 3</td>
<td>31%</td>
</tr>
<tr>
<td>- Segment 4</td>
<td>6%</td>
</tr>
<tr>
<td>Business area 3</td>
<td>21%</td>
</tr>
<tr>
<td>- Segment 5</td>
<td>12%</td>
</tr>
<tr>
<td>- Segment 6</td>
<td>9%</td>
</tr>
</tbody>
</table>

Of the different categories the Swedish Forest Industries Federation uses to classify the produced paper in Sweden, the case company is mainly active in the stable and growing segments; wrapping paper (business area 1), paperboard for packaging (business area 2) and corrugated material (business area 3). The historical production figures of the Swedish Forest Industries Federation in table 2 show that these segments have little or no tendencies of declining global demand.
2.3.1 Business area 1

Business area 1 comprises of segment 1 and segment 2. In addition, the area includes functional solutions for various applications such as packing for food, industrial purposes, medical application and carrier bags with demanding requirements. Moreover any surplus of pulp not used in the case company’s own production is sold and included in business area 1 (The case company website, 2014).

Segment 1 is mainly used for packaging in the food industry (3/5 of the volume) and industrial applications such as medical packaging, hygiene products and steel interleaving (2/5 of the volume). Eco-awareness and political decisions restricting the use of fossil plastics has strengthened the position of paper packaging. Increasing prosperity is driving the demand for hygiene and medical products. Whereas economic growth, especially in Asia, has led to increased demand for “steel interleaving” in the area, with China now being the largest steel producer in the world (The case company website, 2014). According to the case company increased construction in growth regions is boosting the demand for segment 2 as the paper is widely used in the cement industry and in construction material (The case company website, 2014). Segment 1 accounts for approximately 17 per cent of the total sales volume at the case company, while segment 2 and market pulp accounts for 12 per cent and 13 per cent respectively.

2.3.2 Business area 2

Business area 2 comprises of segment 3 and segment 4. Segment 3 is used for milk, juice, other beverages and liquid foods as well as for preserved foods, whereas segment 4 is sold to converters of packaging for, among others; beauty products, confectionery, home electronics and refrigerated and frozen food.

Improved living standards, mainly in Asia and South America, along with increased eco-awareness and increased demand on print quality on finished packaging are said to drive the demand for segment 3 (The case company website, 2014). The same drivers apply to segment 4, in combination with an increased focus on appearance and design of packaging, and increased global consumption in the premium segment (The case company website, 2014). Segment 3 accounts for approximately 31 per cent of the total sales volume whereas segment 4 accounts for approximately 6 per cent (I19, 2014).

The customer composition within segment 3 differs from other segments. The customers essentially comprises of a few large companies (I3; I4; I19, 2014), with whom the case company has long-term contracts running over several years (I19, 2014). The customer composition in the segment is quite the contrast to, for instance, segment 4 with over 500 customers despite a significantly smaller yearly sales volume (I8, 2014). In addition, a large portion of the volume produced within segment 3 is made to stock, whereas production within other segments is mainly
made to order (I3; I4; I19, 2014). The business structure within the segment makes the operations, planning horizons, and lead times quite unique at the company.

2.3.3 Business area 3
Business area 3 consists of segment 5 and segment 6. Segment 5 is mainly sold to producers of corrugated boxes for fruit and vegetables, but is also used by producers for packaging for components in the automotive industry, white goods, electronics and fast food, as well as for transport packaging in corrugated board. Segment 6 is sold to producers of packaging for consumer goods, secondary packaging of corrugated board, and shelf-ready packaging (The case company website, 2014).

Increased demands for environmentally friendly packaging, along with the increased transportations following globalisation and growing populations, are driving the demand for segment 5. Increased focus on hygiene, product safety and demand for sustainable packaging solutions, as well as the increased demand for packaging with excellent printability for in-store sales, are stated to be the main driving forces for segment 6 (The case company website, 2014).

Segment 5 accounts for 12 per cent of the total sales volume whereas segment 6 accounts for 9 per cent.

2.3.4 Production units
The case company has production units in eight locations in three countries. The majority of the production units are located in Sweden.

Table 4 below illustrates the different production units, their location, number of employees, production capacity and products (The case company website, 2014). The table further illustrates that the production units are dedicated to different products. Whereas some production units only produce one product while others, such as production unit 3, produces a variety of products to different business segments. The different natures of the composition of the production units naturally result in different complexities concerning both planning and operations.
<table>
<thead>
<tr>
<th>Production unit</th>
<th>Location</th>
<th>No. of employees</th>
<th>Production capacity (tonnes)</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production unit 1</td>
<td>England, UK</td>
<td>≈ 140</td>
<td>45 000</td>
<td>Segment 1</td>
</tr>
<tr>
<td>Production unit 2</td>
<td>Sweden</td>
<td>≈ 630</td>
<td>430 000</td>
<td>Segment 3, segment 4</td>
</tr>
<tr>
<td>Production unit 3</td>
<td>Sweden</td>
<td>≈ 880</td>
<td>685 000</td>
<td>Segment 1, segment 2, business area 3 (segment 5, segment 6), segment 3, market pulp</td>
</tr>
<tr>
<td>Production unit 4</td>
<td>Sweden</td>
<td>≈ 990</td>
<td>700 000</td>
<td>Segment 3, segment 1 and segment 2</td>
</tr>
<tr>
<td>Production unit 5</td>
<td>Finland</td>
<td>≈ 100</td>
<td>200 000</td>
<td>Segment 1, segment 2</td>
</tr>
<tr>
<td>Production unit 6</td>
<td>Sweden</td>
<td>≈ 430</td>
<td>300 000</td>
<td>Segment 1, segment 2, market pulp</td>
</tr>
<tr>
<td>Production unit 7</td>
<td>Sweden</td>
<td>≈ 640</td>
<td>400 000</td>
<td>Segment 1, segment 2, business area 3 (segment 5), market pulp</td>
</tr>
<tr>
<td>Production unit 8</td>
<td>Finland</td>
<td>≈ 55</td>
<td>100 000</td>
<td>Segment 1</td>
</tr>
</tbody>
</table>
3. Literature Review

The literature review provides a thorough examination of current S&OP literature. It starts with a description of S&OP, followed by a review of key S&OP parameters, and ends with a review of seven different S&OP maturity models identified from a recent and comprehensive research synthesis.

3.1 Sales & Operations Planning (S&OP)

For a long time, early operations management focused entirely on internal operations, all the way from Taylor’s scientific management in late eighteen hundreds up until the mid-twentieth century (Olhager, 2013). By then, the internal manufacturing efficiency was good enough to operate a successful business (Olhager, 2013). It was at this time companies first had to start to find ways to cope with increased competition (Olhager, 2013). This need to look beyond internal operations management has only increased in importance since then, and especially with the increasing globalisation of the world’s markets (Raman & Watson, 2004). One way of coping with this globalisation and competition, which has gained increased influence in both literature and practice since the early 1990’s, is S&OP (Grimson and Pyke, 2007; Olhager, 2013; Sheldon, 2006).

Key features of S&OP are: (1) it has a planning horizon from 3 months to over 18 months (Grimson and Pyke, 2007; Thomé et al., 2012), (2) it integrates separate plans into one plan for the whole company (Olhager, 2013), (3) it is a cross-departmental integrated tactical planning process (Feng et al., 2008; Thomé et al., 2012), (4) it links the strategic plan to the operational plan (Grimson and Pyke, 2007), and (5) it contributes to optimise the profit and performance of the company (Grimson and Pyke, 2007).

Thomé et al. (2012) offer a summary definition of S&OP and its purpose in their comprehensive research synthesis:

“Sales and operations planning (S&OP) is a tool that unites different business plans into one integrated set of plans. Its main purpose is twofold: (1) to balance supply and demand and (2) to build bridges between the business or strategic plan and the operational plans of the firm” (Thomé et al., 2012, p.1).

According to Chopra and Meindl (2013) the goal of S&OP is to handle predictable variability by managing supply and demand in an appropriate combination. By doing this right, they argue that managers can maximise the overall profitability of an entire supply chain. Lapide (2004a) further underlines these claims of the virtues of S&OP with the claim that companies with a fully implemented S&OP process operationally outperform companies with no, or a limited, S&OP process in place.
3.2 S&OP Parameters

As stated above, the main purpose of S&OP is to balance supply and demand (Thomé et al., 2012), and to “bring together all plans for the business (sales, marketing, development, manufacturing, sourcing, and financial) into one integrated set of plans.” (APICS dictionary, 2013c). In other words, the emphasis in S&OP is on plan integration (see e.g. Thomé et al. 2012; Affonso et al., 2008; Grimson and Pyke, 2007). As the main purpose of S&OP is to balance supply and demand and to integrate plans, important elements in the process are demand planning, supply planning, and ways of integrating the different plans. For integration purposes parameters such as information technology, the use of measurements, organisational structure, meeting structures, and planning horizons, are important enablers (Lapide, 2005; Grimson and Pyke, 2007).

Sales and operations planning typically follows a five step process (Grimson and Pyke, 2007; Wallace and Stahl, 2008; Ivert and Jonsson, 2010), although some authors present fewer or more steps (Chen-Ritzo et al., 2010; Cecere et al. 2009). Five main process activities can be identified based on the S&OP process descriptions of Grimson and Pyke (2007), Wallace and Stahl (2008), Ivert and Jonsson (2010) and Cecere et al., 2009 (see appendix I for an overview of the steps in the different process descriptions). The process usually starts with some form of forecasting or demand planning, typically performed by the sales or marketing department (Ivert and Jonsson, 2010; Grimson and Pyke, 2007; Wallace and Stahl, 2008; Cecere et al., 2009). The forecasting process is followed by preliminary supply planning where manufacturing resources and production capacity are considered (Ivert and Jonsson, 2010; Grimson and Pyke, 2007; Wallace and Stahl, 2008; Cecere et al., 2009). The next step involves reconciliation and integration of the plans and involves meetings between managers of sales, marketing, production, financial and logistics departments and the establishment of a final operating plan (Ivert and Jonsson, 2010; Grimson and Pyke, 2007; Cecere et al., 2009). In the next activity, the plan is communicated and distributed in the organisation followed by the implementation (Ivert and Jonsson, 2010; Grimson and Pyke, 2007; Cecere et al, 2009). In the final step the result and effectiveness of the S&OP plan is measured and used for continuous and future improvements (Grimson and Pyke, 2007; Cecere et al., 2009). The identified steps or activities are stated in table 5 below.

<table>
<thead>
<tr>
<th>S&amp;OP process step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Forecasting and demand planning</td>
</tr>
<tr>
<td>Step 2</td>
<td>Supply planning</td>
</tr>
<tr>
<td>Step 3</td>
<td>Plan reconciliation and integration</td>
</tr>
<tr>
<td>Step 4</td>
<td>Plan distribution and implementation</td>
</tr>
<tr>
<td>Step 5</td>
<td>Measurements of results</td>
</tr>
</tbody>
</table>

The following sections present and describe some of the key elements that constitute S&OP.
3.2.1 Demand planning

Wallace and Stahl (2008) describe demand planning as possibly the most difficult and important element in the S&OP process. APICS define demand planning as:

“The process of combining statistical forecasting techniques and judgment to construct demand estimates for products or services (both high and low volume; lumpy and continuous) across the supply chain from the suppliers’ raw materials to the consumer's needs. Items can be aggregated by product family, geographical location, product life cycle, and so forth, to determine an estimate of consumer demand for finished products, service parts, and services. Numerous forecasting models are tested and combined with judgment from marketing, sales, distributors, warehousing, service parts, and other functions. Actual sales are compared with forecasts provided by various models and judgments to determine the best integration of techniques and judgment to minimize forecast error”. (APICS dictionary, 2013d)

In much of the S&OP research, demand planning is focused on customer demand (e.g. Cecere et al., 2009; Grimson and Pyke, 2007; Ivert and Jonsson, 2010). One of the key aspects of the forecasting process is the planning horizon, typically 6-18 months (Grimson and Pyke, 2007) (see further discussion regarding planning horizon in section 3.2.7). The demand planning often starts with forecasting future demand and the collection of data from sales and marketing through collaborative processes (Grimson and Pyke, 2007; Ivert and Jonsson, 2010; Cecere et al., 2009). Cecere et al. (2009), advocate focus on competitive analysis, key customer purchasing behaviour and the use of statistical analysis in combination with management input to consolidate demand from multiple sources. Ivert and Jonsson (2010) separate the initial forecasting from the demand planning, as the former refers to actual market demand whereas the latter refers to a preliminary plan for future sales and delivery volumes. Similarly, Grimson and Pyke (2007) present a process starting with an unconstrained demand forecast capturing what can be sold. The forecast is then adjusted with marketing inputs resulting in a more consensus based demand forecast.

3.2.2 Supply planning

Grimson and Pyke (2007) describe a supply planning process starting with the operations team gathering information about supply chain capacity, internal capacity and possible inventory build-up or draw-down. The operations team then creates an initial supply plan based on the consensus demand forecast and other requirements, taking the capacity constraints into consideration. Ivert and Jonsson (2010) describe a very similar supply planning process and define supply plans as preliminary production plans. The plans are prepared by the production departments and the departments responsible for procurement of production materials. The preliminary supply plans refers to the planned volumes production will deliver during the planning horizon (Ivert and Jonsson, 2010). Cecere et al. (2009) add what-if analysis to the
process in order to determine trade-offs and emphasise the importance of identifying constraints and capacity opportunities in the process.

### 3.2.3 Information technology

Lapide (2004b; 2005) describes information technology as an enabler for a successful S&OP process. Similarly, Affonso et al. (2008) argue that information technology can be used to improve collaboration and integration in the supply chain. Lapide (2005) argues that the software technology has to be chosen to best support the process of the company, less advanced technology is needed for a less advanced S&OP process, and claims that many companies spend large sums on of money on S&OP related software without seeing the benefit because they do not change their process to leverage the enabling technology. Grimson and Pyke (2007) describe information technology as focused on an information process rather than a business process and that information processes are enablers for plan integration. Like Lapide (2005), Grimson and Pyke (2007) advocate more complex information technology for more complex S&OP processes, while spreadsheets may be sufficient for less complex processes. Ivert and Jonsson (2010) propose the use of Advanced Planning and Scheduling (APS) systems in the S&OP process. They identify three potential benefits of using APS systems concerning; decision support, planning efficiency and learning effects. Likewise, Viswanathan (2010) argues that companies with better S&OP processes utilise statistical analysis and enterprise resource planning (ERP) systems to a greater extent than companies with less developed S&OP processes. This notion is also supported by Ventana Research (2006). Lapide (2004b) and Grimson and Pyke (2007) propose the use of an S&OP workbench which is an automated tool for sharing information about sales and operations plans as well as supply- and demand-side metrics such as capacity utilisation and unfulfilled customer demand.

In conclusion, the use of information technology in an S&OP context is vastly discussed within the field. What many authors seem to agree upon is that the information technology has to be selected to best support the S&OP process in use to successfully work as an enabler.

### 3.2.4 Measurements

Grimson and Pyke (2007) argue that the use of measurements is a strong enabler for plan integration and that measurements should apply to both firm performance and effectiveness of the S&OP process. Moreover, they state that measurement of the results and the effectiveness of the S&OP process are essential for both the implementation and for continuous improvements of the process. Similarly, Cecere et al. (2009), advocate the use of measurements of the S&OP plan success for learning and improvements. Some of the measurements Cecere et al. (2009) mention are cash flow, forecast accuracy, expected versus actual profitability, expected versus actual inventories and expected versus actual customer service.

Viswanathan (2010) describes performance management as the ability of an organisation to measure its results to improve business and has identified that companies with more successful
S&OP processes have a better ability to consider KPIs with regards to capacity, forecast accuracy and inventory. Ventana Research (2006) emphasises the importance of assigning measures to individuals and mentions customer service, inventory turns and capacity utilisation as key measurements. In addition to the measurements mentioned above, Grimson & Pyke (2007) emphasise the importance of measurements related to new product introductions such as; development cost, time to market and ramp-up time as well as business measures such as market share and return on invested capital.

3.2.5 Organisation
Grimson and Pyke (2007) argue that a formal S&OP organisation, together with meetings and measurements, are enablers for successful plan integration, and suggest that an S&OP implementation should begin with putting an S&OP team in place. The importance of a cross-functional S&OP team is discussed by many researchers (Cecere et al., 2009; Grimson and Pyke, 2007; Ventana Research, 2006; Lapide, 2004a). Cecere et al. (2009) argue that the S&OP process should be championed by a cross-functional team of senior executives with involvement from marketing, sales, operations, supply procurement, finance and R&D. Ventana Research (2006), states that the best S&OP is done when a cross-functional team is responsible for the plan development. Similarly, Lapide (2004a) states that S&OP needs to be a cross-functional process involving managers from both demand- and supply-side as well as finance personnel to help align the operational plans with the company’s financial objectives. The importance of executive involvement is also emphasised by a majority of the researchers (e.g. Grimson and Pyke, 2007; Lapide, 2005; Cecere et al., 2009; Ventana Research, 2006). For instance Ventana Research (2006) recommend that companies should engage the CEO or CFO as the primary sponsor of the S&OP initiative, and that companies that involve executives have nearly a twice as high success rate compared to those who do not.

3.2.6 S&OP meeting structure and frequency
Most papers addressing the S&OP process emphasise the importance of regular meetings (Thomé et al, 2012; Ventana Research, 2006; Grimson and Pyke, 2007). Generally, the regularity of the meetings varies from quarterly to weekly, with a trend towards more frequent meetings (Lapide, 2004a; Thomé et al; Hahn et al., 2000; Slone, 2004; Grimson and Pyke, 2007). Some researchers also advocate event driven meetings, where management meet to deal with exceptions on an “as-needed basis” (Lapide, 2005; Grimson and Pyke, 2007). Ball (2013) suggests that companies with irregular or no meetings start holding meetings monthly or at a minimum quarterly, but that it might also be necessary with more frequent meetings if business demands it. Wallace and Stahl (2008) describe a monthly S&OP meeting process divided into five steps. The first meeting in the process concerns review and collection of data on supply and demand, inventory and forecasts. The agenda of the second and third meetings are to review the demand plan and to revise the supply plan respectively. The fourth meeting is held in order to prepare for the fifth meeting, which is an executive S&OP meeting that closes the monthly process (Wallace and Stahl, 2008). Lapide (2004a) also discusses sequential meetings. He
presents three steps, or different kinds of meetings, where the first meeting is focused on developing a forecast and unconstrained demand plan. During the second meeting a rough supply plan and a constrained demand plan are established. The third meeting is used to fine tune and complete the alignment of the demand and supply plans. To sum up, although there is no consensus among researchers, most of them emphasise the importance of regular meetings and having a structured meeting agenda.

### 3.2.7 Planning horizons

Grimson and Pyke (2007) describe the existence of planning horizons as long as 3 years into the future but add that they normally are between 6 and 12 months. The reasoning behind the choice of planning horizon is that it should be based on what time of year the planning is done, in combination with consideration to lead times and seasonality. In general, longer lead times require a longer planning horizon for the planning to capture all elements of the supply chain. In much the same manner, a high seasonality requires a longer planning horizon in order to accurately capture the seasonality effect on demand. Finally, the timing of the planning affects the planning horizon on high seasonality markets since it has to be adapted to include a full marketing cycle. Olhager (2013) recommends a 15-18 month time horizon for S&OP with the same reasoning regarding lead times as Grimson and Pyke (2007). Thomé et al. (2012) argue that the planning horizon has to be long enough to support the annual business plan as well as to help in all resourcing decisions, but that it should typically be between 3-18 months. Affonso et al. (2008) agree with the lead time argument but add the requirement of having a planning horizon no shorter than the budget and thus land at a horizon between 12-18 months. Ventana research (2006) recommends an 18 month planning horizon simply based on their findings that a longer horizon generates larger gains than a shorter one. Fleischman et al. (2002) describe planning horizons between 6-24 months of length with no further argument than that it is needed in order to be able to account for seasonality in demand.

To sum up, the most common criteria identified for choice of planning horizon is lead time followed by the need to capture seasonality effects as well as supporting business plans and budgets. The general recommendation seems to be a planning horizon between 6 and 18 months. A summary of the planning horizon lengths and the reasoning behind them is shown in table 6.
3.3 S&OP maturity models

An S&OP maturity model is a diagnostic tool designed for practitioners to assess the current state of an S&OP process, as well as to identify appropriate actions to take in order to improve it (Lapide, 2005). A common trait among these maturity models is a division into a number of states where the first state is the least advanced and the last is the most advanced (Lapide, 2005). Each state, in turn, contains some criteria used in order to assess the state of the investigated S&OP process (Lapide, 2005). These criteria, which can also be seen as elements of an S&OP process, are in turn often divided into groups of similar criteria, for example groups of IT-related criteria or groups of organisational criteria. These groups are in turn referred to as dimensions throughout the rest of this paper. See appendix II for an illustrative example of the states, elements and dimensions of a maturity model.

In an extensive S&OP research synthesis Thomé et al. (2012) review and classify 271 papers of which they choose 55 for systematic review analysis. From these 55 papers, Thomé et al. (2012) identify seven maturity models with a varying number of stages and dimensions. The seven maturity models are the Lapide (2005) four stage model, the Viswanathan (2009a) (Aberdeen group) three stage model, the Grimson and Pyke (2008) five stage model, the Feng et al. (2008) three stage model, the Cecere et al. (2009) four stage model, the Ventana research (2006) four stage model and the Wing and Perry (2001) three stage model. Thomé et al. (2012, p.5) give a brief description of these seven models and suggest that the variation in stages and dimensions are due to difficulties in “summarising results and acquiring cumulative, evidence based results in sales and operations planning”.

These seven maturity models are used as a foundation for the analysis in this thesis and are described in more detail in the following sections.
3.3.1. Lapide, four stage maturity model

Lapide (2005) introduces a four-stage maturity model for S&OP processes, as can be seen in figure 3 below. Each stage is described in terms of three criteria; in what manner and frequency meetings are held, the level of demand and supply chain alignment achieved, and lastly, what type of technologies are implemented to facilitate the process.

**Stage 1: Marginal Process**

The first stage of the maturity model defined by Lapide (2005) is called the “Marginal Process”. In this first and least advanced stage, meetings are sporadic and have a low priority among the participants, and so are often cancelled as a consequence. Lapide describes these types of companies, which do not have any true integration in the supply chain management, as “siloed” companies. Further on, several demand and supply plans are typically developed independently of each other by the demand and supply sides, with little or no effort made to align them. Lastly, the information technology of companies in this stage is typically restricted to spreadsheets developed in a disjoint fashion by individual departments. This technology is described as sufficient for this first stage, since no attempt is made to align the plans, but insufficient for later stages, which require joint planning efforts.

**Stage 2: Rudimentary Process**

Lapide (2005) then goes on to define the second stage which he calls the “Rudimentary Process”. Companies in this second stage of the maturity model have started to implement regular cross-departmental meetings. These meetings do however still have quite low priority among employees, resulting in inadequate preparation and attendance. In this stage, there are still multiple demand plans developed but they are now shared between departments. A synchronised demand plan is then used by the supply-side to align the supply plan with the demand plan. Since plans are still developed independently, the demand side and supply side still often use separate information systems. The demand side typically uses some demand planning software, which output is used by the supply side in their planning process. This is performed by the use of some type of APS software. The output of the supply side planning is typically not communicated back to the demand side at this maturity level.

**Stage 3: Classic Process**

In the third stage described by Lapide (2005), called the “Classic Process”, meetings are held regularly with high attendance by cross-departmental and empowered participants. At this stage, the demand- and supply-side each develop a rough plan aligned to each other. Both demand and supply plans are then open for discussion and adjusted during the cross-departmental S&OP meetings. In more advanced stage three processes, major suppliers and customers are integrated in the information sharing process. Since development of supply and demand plans have to be done jointly in this stage, planning software has to be integrated.
**Stage 4: Ideal Process**

Lapide (2005) defines the fourth and last stage, called the “Ideal Process”, as a process that can never truly be achieved, and which is to be used as a benchmark. At this stage, demand and supply are tracked in real time and virtual meetings are triggered automatically if figures deviate from the plan. An S&OP workbench system needs to be deployed in order to make real time information available to all meeting participants anywhere in the world at all times. It should also support instant plan modifications and display the implications of changes made, or ideally, suggest plan optimisations to the meeting participants. Lastly, most or all suppliers and customers are integrated into the supply and demand planning with the help of collaborative demand and supply collaborator software.

![Figure 3. The Lapide four stage S&OP process maturity model (Lapide, 2005)](image)

### 3.3.2. Viswanathan (Aberdeen group), three stage maturity model

Viswanathan (2010) presents a maturity model with three different maturity stages. The three stages of the Viswanathan maturity model are; “Best in Class”, “Industry Average” and “Laggard”. The “Best in Class” maturity level is made up of the top 21 per cent aggregate performance scorers, the “Industry Average” level is made up of the middle 49 per cent aggregate performance scorers whereas the “Laggard” level consists of the bottom 30 per cent aggregate performance scorers. Four key performance criteria are used to determine the status of an organisation’s S&OP processes. The first criterion concerns the average forecast accuracy. The second criterion concerns the customer service level and to what extent deliveries are on
time and completed to the customer’s requested date. The third criterion concerns the cash conversion cycle where the increase or decrease in cash-to-cash cycle time year over year is considered. Lastly, the year over year gross profit margin improvement is considered.

The measured average class performances of the study are summarised in table 7 below.

Table 7. The measured average maturity class performances of the Viswanathan (2010) study

<table>
<thead>
<tr>
<th>Maturity class</th>
<th>Average class performance</th>
</tr>
</thead>
</table>
| Best in class | 81.9% forecast accuracy (3 months forecast)  
97.2% service level (delivered complete and on time)  
Cash-to-cash cycle time **decreased** by 0.3% year over year  
48.1% year to year gross profit margin improvement |
| Industry average | 58.8% forecast accuracy (3 months forecast)  
92.1% service level (delivered complete and on time)  
Cash-to-cash cycle time **increased** by 0.4% year over year  
34.2% year to year gross profit margin improvement |
| Laggard | 50.8% forecast accuracy (3 months forecast)  
69.1% service level (delivered complete and on time)  
Cash-to-cash cycle time **increased** by 2.4% year over year  
25.4% year to year gross profit margin improvement |

**PACE framework**

To indicate behaviour in specific business processes Viswanathan (2010) uses a PACE (Pressures, Actions,Capabilities, Enablers) framework. The PACE framework works as a methodology to benchmark the business pressures, actions, capabilities and enablers.

Viswanathan (2010) defines the business pressures as external forces that impact the market position, competitiveness and operations of an organisation. The actions are defined as strategic approaches taken in response to industry pressures. The capabilities are the required business process competencies to execute corporate strategy and the enablers are described as the technology solutions required to support the organisation’s business practices.

**Competitive framework**

Furthermore, Viswanathan (2010) describes a competitive framework. According to the framework, enterprises are falling into one of three levels of practices and performance. As for the maturity model, the three classes are “Best in Class”, “Industry Average” and “Laggard”. The “Best in Class” accounts for the top 20 per cent practices that result in top industry performance and superior to the “Industry Average”. The “Industry Average” represents the norm and is made up of 50 per cent of the practices. The “Laggards” represent the 30 per cent practices that are significantly behind the “Industry Average”. Five different categories are
considered when evaluating the enterprises: process, organisation, knowledge, technology and performance. When evaluating the process category, the approaches taken to execute daily operations are considered. The organisation category concerns the corporate focus and the collaboration among stakeholders. Knowledge concerns knowledge management and contextualizing and exposing data to key stakeholders. The technology category reflects the selection and deployment of appropriate tools. Lastly, performance concerns the ability to measure results and improve the business.

There is a relationship between the PACE and competitive framework since the PACE choices a company makes, and how well those choices are executed, strongly affect the achieved competitive performance (Viswanathan, 2010). The achieved competitive performance in turn decides the level of maturity of the company.

3.3.3. Grimson and Pyke, five stage maturity model

Grimson and Pyke (2007) present a five stage maturity model with the Viswanathan three stage maturity model and Lapide four stage maturity model, both described in detail in section 3.3.2. and 3.3.3. of this paper, as their main influences. The goal of their maturity model is explicitly “profit optimization through the integration of sales, operations and finance plans” (Grimson and Pyke, 2007, p. 327). Their maturity model is divided into five dimensions; “meetings and collaboration”, “organisation”, “measurements”, “information technology” and “S&OP plan integration”, where each dimension is ranked on a scale from one to five. In much the same manner as Lapide (2005) they place companies with no S&OP process in the first stage while the fifth and most advanced stage is reserved for companies with an optimal, close to utopian, S&OP process.

Stage 1: No S&OP Process

Grimson and Pyke (2007) define the first stage in their model as having no S&OP process in place, and so aptly name it “No S&OP Process”. In this stage there are no planning meetings and no cooperation between sales and operations. The sales department frequently, and deliberately, inflate their forecasts in order to overcome stockouts and late deliveries from operations. Meanwhile, operations adjust these forecasts downward since they are used to them being inflated. On top of this, both sales and operations departments might have to adjust their forecasts to meet the goals set by the financial department. There is no S&OP function present in the company, neither formal nor informal. Measurements are exclusively in the form of standard financial accounting measures. The information technology is limited to spreadsheets created by individual managers, and these spreadsheets are seldom shared and never consolidated. There can be no S&OP plan integration in this stage since there are neither sales nor demand plans, of any quality, to integrate.
Stage 2: Reactive

Next, Grimson and Pyke (2007) describe the second stage as the “Reactive” stage. In this stage, S&OP is discussed at meetings attended by senior management, although the discussion is primarily based on financial goals. There is still little collaboration, and departments maintain a strong silo-mentality. There is still no formal S&OP function but other employees, with other main tasks, informally perform some functions. Supply plans are based on demand plans, but there is very limited opportunity for supply departments to adjust the demand plan. As in stage one, information technology is limited to individually managed spreadsheets, but with some occurrence of manual consolidation. Regarding integration, demand plans dictate the supply plans, but there is no feedback from the supply department, resulting in poor capacity utilisation.

Stage 3: Standard

Grimson and Pyke (2007) name the third stage the “Standard” stage. This is the first stage where the S&OP process is getting formalised. Formal executive S&OP meetings are held, focusing on integrated S&OP, preceded by S&OP staff meetings where information is shared and initial conflicts addressed. There is some supplier and, or, customer data in the discussions, and meetings are scheduled weekly or monthly with little or no S&OP discussions in between. In this stage, there is often still no formal S&OP team, and S&OP functions are usually performed by supply chain managers or product managers. Companies in this stage measure both effectiveness of operations and the accuracy of sales forecasts. Also, the sales managers developing the sales forecast are now held responsible for its accuracy. In this stage, companies use revenue and operations planning software and information is automatically centralised. The demand plan is still the main driver of the supply plan, but some supply information may impact the demand plan. Companies in the third stage of the model develop their forecasts bottom-up.

Stage 4: Advanced

The fourth stage is defined as the “Advanced” stage by Grimson and Pyke (2007) and as the last stage which is reasonable for any present day company to reach. In this stage, a greater selection of suppliers and customers attend meetings, participate in discussions and contribute with data to be incorporated. Companies in the advanced stage have established teams, with executive participation, in which all members have a formal S&OP job title. In addition to stage three measurements, new product introduction and S&OP effectiveness are now measured as well. The “new product introduction measurement” captures added dynamics from not having any reliable historic data of the product. “Forecast accuracy” and “on time deliveries” are examples of measurements that can be used to track S&OP effectiveness. Information technology consists of revenue and operations optimisation software used in a separate or sequential manner. In addition, an S&OP workbench is implemented, a system for distributing S&OP information, which can be accessed by the entire organisation. The development of sales and demand plans are now developed through collaboration. The capacity constraints are set by both marketing and operations, and all planning is done in a concurrent rather than sequential fashion.
Stage 5: Proactive

Grimson and Pyke (2007) define the fifth and last stage of their model as unobtainable for present day companies and name it the “Proactive” stage. Scheduled meetings in this stage follow the description of stage four meetings but they can be interrupted by event driven meetings at any time. Both internal and external supply chain personnel have real-time access to internal and external data. The organisation is much like that of a stage four company, with a formal S&OP team and executive participation, but in this final stage the S&OP process is understood and respected by the entire organisation. Measurements are the same as in stage four with the addition of company profitability. The profitability is reported to the S&OP team and the team is, at least partially, responsible for it. Information technology in stage five delivers real-time integrated solutions, which optimise sales and demand decisions in a joint fashion. The S&OP planning integration in stage five optimises demand and supply at the same time in order to maximise profitability for the entire company.
### Table 8. Grimson and Pyke (2007), five stage maturity model.

<table>
<thead>
<tr>
<th>Meetings &amp; Collaboration</th>
<th>Stage 1 No S&amp;OP Process</th>
<th>Stage 2 Reactive</th>
<th>Stage 3 Standard</th>
<th>Stage 4 Advanced</th>
<th>Stage 5 Proactive</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Silo culture</td>
<td>- Discussed at top level management meetings</td>
<td>- Staff Pre-Meetings</td>
<td>- Supplier &amp; customer data incorporated</td>
<td>- Event driven meetings supersede scheduled meetings</td>
<td></td>
</tr>
<tr>
<td>- No meetings</td>
<td>- Focus on financial goals</td>
<td>- Executive S&amp;OP Meetings</td>
<td>- Suppliers and customers participate in parts of meetings</td>
<td>- Real time access to external data</td>
<td></td>
</tr>
<tr>
<td>- No collaboration</td>
<td></td>
<td>- Some Supplier/Customer data</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Organisation            | - No S&OP organisation | - No formal S&OP function | - S&OP functions is part of other position: Product Manager, Supply Chain Manager | - Formal S&OP team | Throughout the organisation, S&OP is understood as a tool for optimising company profit |

| Measurements             | - No measurements | - Measures how well operations meet sales plan | - Stage 2 plus: Sales measured on forecast accuracy | - Stage 3 plus: New product introduction | - Stage 4 plus: Company profitability |

| Information Technology   | - Individual managers keep own spreadsheets | - Many spreadsheets | - Centralised information | - Batch process | - Integrated S&OP optimisation software |
|                          | - No consolidation of information | - Some consolidation but done manually | - Revenue or operations planning software | - Revenue and operations optimisation software link to ERP but not jointly optimised | - Full interface with ERP, accounting, forecasting |

| S&OP Plan Integration    | - No formal planning | - Sales plan drives operations | - Some plan integration | - Plans highly integrated | - Seamless integration of plans |
|                          | - Operations attempts to meet incoming orders | - Top-down process | - Sequential process in one direction only | - Concurrent & collaborative process | - Process focuses on profit optimisation for whole company |
|                          |                        | - Capacity utilisation dynamics ignored | - Bottom up plans tempered by business goals | - Constraints applied in both directions |
3.3.4. Feng et al. Three stage maturity model
Feng et al. (2008) develop models to enable calculation of the benefits from implementing an S&OP process. The models are developed for three different stages of S&OP maturity and thus constitute the different stages of a maturity model. Feng et al. (2008) classify the stages after the level of planning structure integration, where the planning structure comprises sales, production, distribution, and procurement planning. In the first stage the planning structure has no integration, meaning that there is no integration between sales, production, distribution, or procurement planning. This stage is aptly named “Decoupled Planning”. In the second stage, the sales and production planning are integrated while the distribution and procurement planning are still separated. This stage is named “Sales-Production Planning-Based S&OP”. In the third and final stage the planning structure is fully integrated, meaning that sales, production, distribution, and procurement planning are all integrated. This final stage is called “Supply-Chain-Based S&OP”.

3.3.5. Cecere et al. Four stage maturity model
Cecere et al. (2009) present a four stage maturity model arranged in increasing order of organisational balance. These four stages are “Reacting”, “Anticipating”, “Collaborating” and “Orchestrating”. The stage of the investigated sales and operations planning process is in turn dependent on four dimensions; balance between sales and operations planning, goal, ownership and metrics.

Stage 1: Reacting
In the first stage, Cecere et al. (2009) describe the balance of the S&OP as heavily leaning towards the operational side. Sales have ownership of sales and operations have ownership of factory capabilities. The goal is to develop an operational plan and metrics measured are order fill rate, asset utilisation and inventory levels.

Stage 2: Anticipating
In the second stage, or the “Anticipating” stage, Cecere et al. (2009) depict a slightly more balanced picture between sales and operations planning. Operations are still more dominant in the planning process but the marketing function and factory capability are now integrated in the S&OP. The goal at this stage is to match demand with supply, and the metrics measured are order fill rate, forecast error, inventory turns and functional costs.

Stage 3: Collaborating
In the third stage, Cecere et al. (2009) describe S&OP as almost completely balanced. The sales side is owner of go-to-market plans while operations have ownership of the design of the demand-driven plan, and the make and deliver processes. The goal of the S&OP process at this stage is profitability, and the metrics measured are demand error, customer service, working capital and total costs.
Stage 4: Orchestrating

The last stage is described by Cecere et al. (2009) as having complete balance between the sales and operations planning. In this stage, sales has ownership of go-to-market strategies and solutions while operations has ownership of translating the demand into plan, make, deliver, source, and service strategies, with connection to execution. The goal at this final stage is described as “demand sensing, and conscious trade-offs for demand shaping to drive an optimised demand response” (Cecere et al., 2009, p. 2). The metrics measured are demand risk, customer service, cash flow, market share and profit.

3.3.6. Ventana research, four stage maturity model

Ventana Research (2006) proposes a maturity model where maturity is ranked in four levels: tactical, advanced, strategic and innovative. At the tactical level, the S&OP is solely focused on basics such as balancing supply and demand. At the advanced level the company has progressed beyond the basics of S&OP and introduced formal planning and review meetings. At the strategic level, S&OP is used to align operational planning with corporate strategic objectives. At the final stage, the innovative level, companies use a variety of performance management techniques to run S&OP. At this stage people, processes, and technologies are aligned and operations are tied to objectives.

3.3.7. Wing and Perry, three stage maturity model

Wing and Perry (2001) develop a three-stage framework focused on information technology and information integration. The different stages are summarized below.

Stage 1: An integrated planning solution

In the first stage Wing and Perry (2001) describe all material and capacity constraints across the enterprise as simultaneously optimised and synchronised. In the planning model of the first stage, demand forecasts are fed automatically to an optimisation engine and the effects of changes in forecasts can quickly be understood. The optimisation engine models all critical material and capacity resources in the extended supply chain. In addition, internal and external constraints such as potential bottlenecks in manufacturing plants, quality control and suppliers are included in the model.

Stage 2: Collaboration with trading partners

In the second stage Wing and Perry (2001) describe collaboration with trading partners as expanded. Collaborative relationships with customers allow for faster information exchanges, and forecasts are synchronized with customers’ plans in order to improve accuracy. For instance, viewing of customers’ replenishment plans and comparing them with forecasts help to identify discrepancies. Similar processes apply to a collaborative relationship with suppliers.
Stage 3: The network hub

According to Wing and Perry (2001), the third and final stage includes the creation of a network hub that connects all participants through all levels of the extended supply chain. Participants are in constant communication with the hub, the planning is continuous, and all relevant participants are simultaneously notified of events and conditions that might impact the current plan. If for instance sales are higher than expected, all participants on the supply side would receive the same demand signal simultaneously and production plants would see a forthcoming change to scheduling.

3.4 Dimensional analysis of maturity models

This section contains a comparative analysis of the dimensions of the seven maturity models introduced in section 3.3. By comparing the dimensions, the common denominators can be found and used in order to identify the most comprehensive model for use in the analysis of the case company. Furthermore, comparing the dimensions can help to identify deviating elements to complement the model, and produce a more complete picture of the maturity level of the case company. The Grimson and Pyke (2007) model presented in section 3.3.3 was identified during the initial literature review as the most comprehensive of the maturity models, and is thus used as reference throughout the following comparisons. It can therefore be helpful to have table 8 in mind while reading the following sections. The common elements identified in the comparison are presented in section 3.4.1 while the deviating elements are presented and analysed in section 3.4.2. We strongly recommend readers to continuously refer to table 9 while reading section 3.4.1 and 3.4.2 in order to easier grasp the comparison.

3.4.1 Common elements

Lapide

As the Grimson and Pyke (2007) maturity model is largely based on the Lapide (2005) maturity model, most elements are encompassed and there is a good fit between dimensions. By comparing the dimensions of the Lapide (2007) maturity model to the dimensions of the Grimson and Pyke (2007) maturity model, it is found that; the “process” dimension corresponds to the “S&OP plan integration” dimension, the “technology” dimension corresponds to the “IT-structures” dimension, and the “meeting structure” dimension corresponds to the “meetings and collaboration” dimension. There are however two additional elements from dimensions outside of the “meeting structure” dimension of Lapide (2005) that fit into the “meetings and collaboration” dimension of Grimson and Pyke (2007). These two elements of the Lapide (2005) model are “supplier/customer collaboration” from the process dimension and “integration of external data” from the “technology” dimension. Finally, there is one deviating element from the “meeting structure” dimension of the Lapide (2005) model called “meeting attendance”, which is discussed in section 3.4.2.
Viswanathan

The “performance management” dimension of Viswanathan (2010) is a perfect match with the “measurements” dimension of Grimson and Pyke (2007). The “technology management” dimension of Viswanathan (2010) goes a little further in the description of IT-systems by adding two additional elements to the IT-structure, which refer to the utilisation of custom legacy systems and best of breed IT-solutions. These elements remain quite vague however and could thus be considered to be equivalent to some of the elements of other maturity models, depending on how they are interpreted. In this case, the elements are considered to be covered by the descriptions of information technology systems offered by Grimson and Pyke (2007) in the fourth and fifth stage of their model. Further on, the “process” dimension of Viswanathan (2010) is directly comparable to the “S&OP plan integration” dimension of Grimson and Pyke (2007), but with the addition of inventory management in the former, further discussed in section 3.4.2. The “organisation” dimension of Viswanathan (2010) is entirely encompassed by the Grimson and Pyke (2007) model but divided between the two dimensions “organisation”, and “meetings and collaboration”. The biggest difference between the models is the inclusion of a “knowledge management” dimension in the Viswanathan (2010) model, further discussed in section 3.4.2. Three elements of this dimension do however fit into the “organisation”, and “meetings and collaboration” dimensions of the Grimson and Pyke (2007) model.

Feng et al.

The maturity model developed by Feng et al. (2008) is entirely encompassed by the Grimson and Pyke (2007) maturity model. This is quite unsurprising considering that Feng et al. (2008) view integration as the only dimension of their model while Grimson and Pyke (2007) have five dimensions out of which one is “S&OP plan integration”. Thus the entirety of the Feng et al. (2008) maturity model fit within the “S&OP plan integration” dimension of Grimson and Pyke (2007).

Wing and Perry

As in the case of the Feng et al. (2008) model, the Wing and Perry (2001) maturity model is one-dimensional. However, where Feng et al. (2008) focus on integration, Wing and Perry (2001) base their model on “IT-integration”. This “IT-integration” dimension is almost a complete fit with the Grimson and Pyke (2007) maturity model except for one element, “models reflect third party constraints”, discussed further in section 3.4.2. Although the focus of Wing and Perry (2001) is entirely IT based, some of the elements were found to have a match with other dimensions than the expected “IT-structure” dimension of Grimson and Pyke (2007). The “customer integrated in IT-structure” and “ability to quickly identify exceptional situations” elements from Wing and Perry (2001) can be found in the fourth and fifth stages of the “meetings and collaboration” dimension of Grimson and Pyke (2007). Further on, the “S&OP planning models encompass all capacity constraints” element fit into the fourth stage of the “S&OP plan integration” dimension of Grimson and Pyke (2007).
Cecere et al.

The “metrics” dimension of the Cecere et al. (2009) maturity model is very similar to the “measurements” dimension of the Grimson and Pyke (2007) model. It does however, like the Viswanathan (2010) model, include an inventory element, further discussed in section 3.4.2. The remaining three dimensions all fit into the “S&OP plan integration” dimension of the Grimson and Pyke (2007) model.

Ventana Research

The “performance management” dimension fits almost perfectly into the “measurements” dimension of the Grimson and Pyke (2007) model. Only the “linking strategy with corporate goals and objectives” element is deviating, but can still be fitted into the “S&OP plan integration” dimension and is thus still encompassed by the model. The “people” dimension is mainly divided between the two Grimson and Pyke (2007) dimensions; “meetings and collaboration”, and “organisation”. One element; “evaluation of the effectiveness of the overall S&OP process”, does however fit in the fourth stage of the Grimson and Pyke (2007) “measurements” dimension. Furthermore, the Ventana Research’s (2006) “technology” dimension is almost entirely encompassed by the Grimson and Pyke (2007) “IT-structures” dimension. Two deviating elements were however identified from this dimension and are further discussed in section 3.4.2. The “process” dimension is quite fragmented. While most of the “process” dimension elements can be fitted into the “S&OP integration dimension” of Grimson and Pyke (2007), some elements fit best into the “meetings and collaboration” dimension, and “measurements” dimension respectively. Finally, the “planning horizon” element of the “process” dimension cannot be found in the Grimson and Pyke (2007) model and is further discussed in section 3.4.2.

3.4.2 Deviating elements

Meeting attendance

“Meeting attendance” is the only element of the Lapide (2005) maturity model not covered by the Grimson and Pyke (2007) model. By including this “meeting attendance” element in the maturity model, Lapide (2005) emphasises the importance of prioritising S&OP meetings among participants in the S&OP team. A higher priority leads to a higher participation and by extension to a higher meeting attendance.

Planning horizons

Planning horizons are widely discussed in S&OP literature (see section 3.2.2), but are not a common element in S&OP maturity models. In fact, the Ventana Research (2006) maturity model is the only one of the models analysed that considers planning horizons to be a criteria for S&OP maturity.
**Metrics**

Another recommendation made by Ventana Research (2006), which falls outside of the Grimson and Pyke (2007) maturity model, is to ensure accountability for all metrics and well-defined processes. This has also been identified during the interview process in which interviewees stressed the importance of accountability of individual forecasts in order to produce accurate prognoses (I6; I8, 2014).

**Knowledge management**

The Viswanathan (2010) model has one unique dimension called “knowledge management” which is not encompassed by the Grimson and Pyke (2007) model or any other of the investigated maturity models. This dimension emphasizes the knowledge and understanding of the other dimensions among the employees of the organisation. Consequently, implementation of processes, meetings, IT-structures and measures are not enough on their own in order to be “best-of-breed”, unless understood and employed in a correct manner.

**IT-structure**

Wing and Perry (2001) add one element to the “IT-structure” dimension, not included in the Grimson and Pyke (2007) model, or any of the other models. They suggest that implemented IT-structures should not only be able to integrate customer data, a criterion found in the Grimson and Pyke (2007) model, but also be able to reflect third party constraints.

**Inventory**


**3.4.3 Summary**

Table 9 shows an overview of the maturity model comparison described in section 3.4.1 and 3.4.2 in the form of a comparison matrix. The Grimson and Pyke (2007) maturity model serves as a reference to the other models since it was identified as the most comprehensive of the investigated maturity models during the initial literature review. All common elements identified in section 3.4.1 has hence been placed in the column corresponding to a dimension of the Grimson and Pyke (2007) maturity model, while deviating elements have been placed in a sixth column for further analysis. Models with no elements in the sixth column are hence entirely
encompassed by the Grimson and Pyke (2007) maturity model, which further supports the notion of it being the most comprehensive of the investigated models.
Table 9. Maturity model comparison matrix. The five dimensions of the Grimson and Pyke (2007) maturity model on the horizontal axis, and the maturity models compared to it on the vertical axis.

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<th>Measurements</th>
<th>IT-structures</th>
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4. Methodology

The methodology chapter begins with an identification of the research paradigm followed by a justification of the choice of methodology and methods. This is followed by a description of the research approach and process, and ends with a discussion of the limitations and ethical aspects of the research design.

4.1 Identification of paradigm

The aim of this study is to develop a maturity model tailored to the process industry. This aim is reached through a partly deductive approach, where comparative analysis of developed theories are used in order to evaluate empirical observations, and a partly inductive approach, where empirical observations made in a case study context are used in order to develop new theories. The empirical observations in this study consist of primarily qualitative data and were mainly collected through in-depth semi-structured interviews. The choice of method and use of mainly qualitative data place the study in the interpretivism paradigm.

4.2 Case studies

4.2.1 Definition

A case study is a type of methodology incorporating a number of methods, typically used in interpretivist studies in order to obtain in-depth knowledge of a single phenomenon by studying it in its natural setting (Collis and Hussey, 2009).

Yin (2009) offers a definition of case studies characteristics:

“1. A case study is an empirical inquiry that
   ● Investigates a contemporary phenomenon in depth and within its real-life context, especially when
   ● the boundaries between phenomenon and context are not clearly evident.

2. The case study inquiry
   ● copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result
   ● relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result
   ● benefits from the prior development of theoretical propositions to guide data collection and analysis. “ (Yin, 2009, p.18)

The use of a case study as methodology is preferred when the research investigates a real-life contemporary issue over which the researcher has little control (Yin, 2009).
4.2.2 Types

Case studies can be divided into five main types depending on the purpose of the study:

1. *Exploratory* case studies develop theories and hypotheses for why a current practice is used (Scapens, 1990; Yin, 2009).
2. *Explanatory* case studies use theory to explain current practice (Scapens, 1990; Yin, 2009).
4. *Illustrative* case studies illustrate new and often innovative practices of firms (Scapens, 1990).
5. *Descriptive* case studies describe the current practise of one or several firms (Scapens, 1990; Yin, 2009).

This case study is of both experimental and descriptive type. It is of experimental type since it studies the difficulties of implementing a general S&OP maturity model to a company in the process industry, as well as the benefits of a process industry specific maturity model. But it is also descriptive as it describes the current practise of a firm.

4.2.3 Design

Yin (2009) describes four types of case study designs. A case study can be either holistic, and have a single unit of analysis, or be embedded, and have multiple units of analysis. These two types can then be divided into single case or multiple case designs.

There are five rationales for using a single case study design, according to Yin (2009). First, when the purpose is to test a well-formulated theory and the case represents a critical case. Second, if the case is of an extreme or unique character, making it hard or impossible to find any more cases of the same character at that point in time. The third rationale is if the case is representative or typical for a certain situation. Fourth, it is rational to use when the case is of a revelatory nature. That is, if the researcher can investigate a phenomenon which has been previously inaccessible. The fifth and last rationale is when the same case is studied at more than one point in time.

The choice of holistic or embedded design is foremost dependent on the existence of identifiable subunits of the examined organisation (Yin, 2009). The holistic design is the logical choice when no subunits can be identified, while it may lead to very abstract results and unsuitable simplifications if applied to an organisation with subunits present (Yin, 2009). For these situations, where subunits can be identified, the embedded design is preferred. There is however the potential pitfall with the embedded design of unduly focus on the subunits, and therefore a risk of missing out on the larger picture (Yin, 2009).
The aim in this study has been to maintain an embedded design approach. This has been done by examining each separate business area as subunits for analysis where possible, and thus also captured differences stemming from the former company X and company Y organisations. This approach has however been abandoned for a more holistic approach at times since integral parts of the supply chain, such as the supply chain management, and sales and operations planning, are joint functions and could thus not be treated as subunits.

4.2.4 Stages
Collis and Hussey (2009) and Scapens (1990) both describe a five step process for writing a case study. While different in their choice of step headlines, they both describe a fundamentally similar process. While Collis and Hussey name their fourth step “data analysis”, it includes both to become totally familiar with the data and to identify patterns, much the same as the activities included in the third and fourth steps of Scapens (Collis and Hussey, 2009; Scapens, 1990). Further on, Scapens (1990) assumes that the case is already selected at the first stage, and the “preparations” is described in much the same way as Collis and Hussey (2009) describe their second stage “preliminary investigation”. This study has been conducted with a combined approach but with the same basic elements. All three five step approaches can be seen in table 10.

The preparation of the case study is imperative for its success, and one way to do this is by conducting a literature review (Yin 2009). Yin (2009) does however stress the role of the literature review as a means to an end rather than an end in itself, and that it should be used in order to identify gaps in literature rather than to answer what is already known. With this in mind, this study is initiated by a thorough review of the S&OP literature in order to chart the field of study and identify gaps in the field of research.

The three main methods for data collection in a case study are interviews, documentation, and observations (Collis and Hussey, 2009; Scapens, 1990). These can be used in isolation but Collis and Hussey (2009) recommend them being used in combination and Scapens (1990) emphasise the importance to be open for all information and clues at all times. This study implements interviews as a main tool for data collection, but does also collect documentation and, to some degree, make use of on location observations.

Data analysis can be done in one of two ways; either as a within-case analysis, or as a cross-case analysis (Collis and Hussey, 2009). Collis and Hussey (2009) stress the importance of total familiarity with the collected material when using “within-case analysis”. Therefore, as this study is conducted with the mentioned approach, steps are taken in order to optimise the analysis process described further in section 4.4.

The final step is to write the actual report (Scapens, 1990; Collis and Hussey, 2009). It is important for the report to explain all the circumstances of the case in a convincing manner so
that readers trust the reasoning behind any explanations offered (Scapens, 1990). Further on, Collis and Hussey (2009) stress the importance of comprehensive quotation from the collected data and the use of diagrams in an imperative case study.

Table 10. Five step approaches for writing a case study (Scapens, 1990; Collis and Hussey, 2009)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Preparations</td>
<td>Selecting the case</td>
<td>Literature review</td>
</tr>
<tr>
<td>2</td>
<td>Collecting evidence</td>
<td>Preliminary investigation</td>
<td>Data collection</td>
</tr>
<tr>
<td>3</td>
<td>Assessing evidence</td>
<td>Data collection</td>
<td>Data preparation</td>
</tr>
<tr>
<td>4</td>
<td>Identifying and explaining patterns</td>
<td>Data analysis</td>
<td>Data analysis</td>
</tr>
<tr>
<td>5</td>
<td>Report writing</td>
<td>Writing the report</td>
<td>Report writing</td>
</tr>
</tbody>
</table>

4.2.5 Virtues
Yin (2009) argues that there are a lot of prejudices about the case study design, and stresses that it is a strong method with a lot of virtues. The case study is the preferred method for studying contemporary events which cannot be manipulated by the investigator. Its strongest attribute, which is unique for the case study method, is its ability to handle multiple sources of evidence such as interviews, documents and observations. Further on, Yin (2009) describes case studies as contributing with two sources of evidence:

1. Direct observation of events being studied
2. Interviews with people involved in the events under study

Yin (2009) also argues for the unique ability of case studies to investigate “how” and “why” certain experiments work and should therefore be considered a valuable complement to experimental methods rather than an alternative to them.

4.2.6 Criticism
Gummesson (1991) lists three common points of criticism towards case studies:

1. Case studies lack statistical reliability and validity
2. Case studies can be used to generate hypotheses but not to test them
3. Generalisations cannot be made on the basis of case studies

Yin (2009) adds two other common criticisms:

- Case studies take too long and result in massive unreadable documents
- Single case studies are subjected to unique or artifactual conditions due to for example special access to a key informant
On the first point of criticism, Yin (2009) states that, contrary to common belief, a case study can be of high validity and quality even solely through the use of telephone or Internet, if used for studying the right topic. Further on, Yin (2009) debates the third point of criticism regarding the lack of generalisations that can be made from case studies. While he agrees that generalisations based on case studies cannot be made in a statistical sense, he argues that the goal should rather be analytical generalisation, which is to expand and generalise theories rather than generalising a sample to a population. Finally, Yin (2009) means that the perception that case studies take too long to conduct is because they are confused with specific methods of data collection such as ethnography or participant-observation.

4.3 Interview approach

In this study mainly semi-structured interviews are used as data gathering method in order to allow interviewees to reflect and present aspects unique to them and to avoid interesting aspects from being excluded.

Oliva and Watson (2011) present a case analysis of supply chain planning from a process perspective, using an interview approach. The interview protocol of Oliva and Watson (2011) can essentially also be used to identify the maturity level of a company’s S&OP process. Similarly Grimson and Pyke (2007) interview 15 companies to create a framework for S&OP and to establish a company’s S&OP maturity level. The interview approach of Grimson and Pyke (2007) is described in detail and the interview template of their study is available. It can therefore also be used as a base when conducting the interviews for this study. Therefore, a merge of the interview approaches was used where questions from the Oliva and Watson protocol were used for introductory and background checking, while questions from the Grimson and Pyke protocol were used for more detailed mapping of the S&OP process. This new merged interview protocol was used for all interviews throughout this study. See appendix III for the interview protocol used in all interviews.

All interviewees were first approached by an email introducing the writers, the purpose of the study and then inquiring the willingness to participate in a telephone-interview lasting approximately 30-45 minutes. Out of the 21 employees approached, 20 responded and chose to participate. Out of these 20, 19 were asked to suggest a time and date for the interview, and to submit a preferred means of contact. In order to improve the credibility of the research as well as to minimise the risk of misinterpretation of responses, all participants were asked for consent to record the interview. All 19 participants accepted that the interview was recorded, two requested to receive the transcript after the interview, and another five asked to receive the final paper.
4.4 Qualitative data analysis

A study under an interpretive paradigm typically seeks non quantitative data with richness and depth, and can therefore easily amount to overwhelming masses of qualitative data in the form of interview transcripts, field notes and published documents (Collis and Hussey, 2009). For this reason, a number of non-quantifying methods have been developed for interpretivist studies in order to help researchers analyse qualitative data in an effective manner (Collis and Hussey, 2009). Collis and Hussey (2009) describe the main features of qualitative data analysis as; reducing the data and restructuring the data.

4.4.1 Reducing the data
Collis and Hussey (2009) suggest reduction of the data as the first step to handle large quantities of qualitative data. They mean that reducing the data helps to sort, focus, and reorganise the data which in turn helps in the process of reaching and verifying conclusions.

The 19 interviews conducted in this study resulted in almost 10 hours of interviews and 70,844 words of transcribed material. Data reduction was subsequently a very relevant technique in this case. It was used to sort out obviously irrelevant data while all possibly relevant data was left intact. This resulted in an average reduction of the transcribed interviews by 28.94 per cents, as shown in table 11.

Table 11. Overview of interview length, word count and per cents reduced

<table>
<thead>
<tr>
<th>Interview</th>
<th>Time</th>
<th>Words before</th>
<th>Words after</th>
<th>Per cents reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>0:21:57</td>
<td>2944</td>
<td>2120</td>
<td>27.99%</td>
</tr>
<tr>
<td>I2</td>
<td>0:55:26</td>
<td>7176</td>
<td>2927</td>
<td>59.21%</td>
</tr>
<tr>
<td>I3</td>
<td>0:37:58</td>
<td>4173</td>
<td>3466</td>
<td>16.94%</td>
</tr>
<tr>
<td>I4</td>
<td>1:03:40</td>
<td>7508</td>
<td>4248</td>
<td>43.42%</td>
</tr>
<tr>
<td>I5</td>
<td>0:35:29</td>
<td>5195</td>
<td>3114</td>
<td>40.06%</td>
</tr>
<tr>
<td>I6</td>
<td>0:34:15</td>
<td>3509</td>
<td>2700</td>
<td>23.06%</td>
</tr>
<tr>
<td>I7</td>
<td>0:26:14</td>
<td>3693</td>
<td>2547</td>
<td>31.03%</td>
</tr>
<tr>
<td>I8</td>
<td>0:39:24</td>
<td>3528</td>
<td>2956</td>
<td>16.21%</td>
</tr>
<tr>
<td>I9</td>
<td>0:37:20</td>
<td>5031</td>
<td>3746</td>
<td>25.54%</td>
</tr>
<tr>
<td>I10</td>
<td>0:26:52</td>
<td>2409</td>
<td>1946</td>
<td>19.22%</td>
</tr>
<tr>
<td>I11</td>
<td>0:16:22</td>
<td>2681</td>
<td>2128</td>
<td>20.63%</td>
</tr>
<tr>
<td>I12</td>
<td>0:32:50</td>
<td>4422</td>
<td>3587</td>
<td>18.88%</td>
</tr>
<tr>
<td>I13</td>
<td>0:20:48</td>
<td>2297</td>
<td>1465</td>
<td>36.22%</td>
</tr>
<tr>
<td>I14</td>
<td>0:13:24</td>
<td>1872</td>
<td>1457</td>
<td>22.17%</td>
</tr>
<tr>
<td>I15</td>
<td>0:24:03</td>
<td>2344</td>
<td>1563</td>
<td>33.32%</td>
</tr>
<tr>
<td>I16</td>
<td>0:25:19</td>
<td>2536</td>
<td>2082</td>
<td>17.90%</td>
</tr>
<tr>
<td>I17</td>
<td>0:34:28</td>
<td>3908</td>
<td>2465</td>
<td>36.92%</td>
</tr>
<tr>
<td>I18</td>
<td>0:18:46</td>
<td>1878</td>
<td>1213</td>
<td>35.41%</td>
</tr>
<tr>
<td>I19</td>
<td>0:27:11</td>
<td>3740</td>
<td>2776</td>
<td>25.78%</td>
</tr>
<tr>
<td>Total</td>
<td>9:51:46</td>
<td>70844</td>
<td>48506</td>
<td>28.94%</td>
</tr>
</tbody>
</table>
4.4.2 Restructuring the data

The next step according to Collis and Hussey (2009) is to restructure the data. How the data is restructured depends on the method of collection and, or, the use of a theoretical framework. If a theoretical framework is used, there may already exist a suitable structure for the data, if not, one may emerge during the data collection stage.

In this study, the reduced data was restructured in an excel matrix with the five dimensions of Grimson and Pyke (2007) on the vertical axis and the interviewees on the horizontal axis. Each reduced interview was then scanned for elements of the Grimson and Pyke (2007) maturity model and entered in the corresponding cell where dimension and interviewee met. An example of the result of the restructuring of data can be seen in table 12, while the full matrix can be found in appendix IV.
### Table 12. Restructuring of reduced interview data.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Position</strong></td>
<td><strong>Director, sales</strong></td>
<td><strong>Director, Supply Chain Management</strong></td>
<td><strong>Manager, Supply Chain management</strong></td>
<td><strong>Director, Supply Chain Management</strong></td>
</tr>
<tr>
<td><strong>Part of organisation</strong></td>
<td><strong>Business area 1</strong></td>
<td><strong>Business area 2</strong></td>
<td><strong>Business area 1-3</strong></td>
<td><strong>Business area 1-3</strong></td>
</tr>
<tr>
<td><strong>Meetings &amp; Collaboration</strong></td>
<td>Stage 1: No collaboration - No internal crossfunctional collaboration to speak of.</td>
<td>Stage 1: No collaboration - There are meetings (not specifically for planning purposes) at each production site between production planners and production. These are on an operational level however. There appears to be some slicing between sales and operations.</td>
<td>Stage 1 (1,5): No meeting - No formal planning meetings between sales and production except receiving sales/production plans. Meeting between production and &quot;supply chain&quot; as well as meeting between market and &quot;supply chain&quot;.</td>
<td>Stage 1: No meetings - No formal S&amp;OP meetings.</td>
</tr>
<tr>
<td></td>
<td>Stage 1 (1,5): No meetings - No formal S&amp;OP meetings. No regular crossfunctional meetings except for during planned stops, then mainly with production planners. However, Meetings once a month to discuss how well the production/sales meet the sales plan.</td>
<td>Stage 2: Focus on financial goals - Sales and supply planning based on the annual financial budget.</td>
<td>Stage 2: Focus on financial goals - Planning based on the annual financial budget.</td>
<td>Stage 1 (1,5): Silo culture - No link between sales and production, except making sure the total volumes match.</td>
</tr>
<tr>
<td></td>
<td>Stage 2: Focus on financial goals - Sales and supply planning based on the annual financial budget.</td>
<td>Stage 2: Some supplier/customer data - Collect input from the larger customers to prepare the sales forecast. Sometimes by phone and sometimes through physical meetings. E.g. can large customers do without these volumes during the planned stop so that they don't need to build inventory</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stage 3: Some supplier/customer data - Segment 1 - Receive some market intelligence and customer intelligence from large customers. Receive yearly demand prognosis from largest customers</td>
<td>Not stage 3: Some supplier/customer data - No supplier involvement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stage 4: Suppliers and customers participate in parts of meetings - Segment 3: Meetings that partly addresses (S&amp;OP) planning with largest customers</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Organisation</strong></td>
<td>Stage 2: Measures how well operations meet sales plan - Monitor volume of production and sales against sales plan.</td>
<td>Stage 1: No measurements - OVERALL ORGANISATION - No measurements connected to forecast accuracy or how well operations meets the sales plan etc.</td>
<td>Stage 2: Measures how well operations meet sales plan - Production is followed up and compared with production budget. There are however no measurements of forecast accuracy.</td>
<td>Stage 2 (1,5): Measures how well operations meet sales plan - Measures how well the production budget is met. (Use of KPI such as OTIF, measured monthly.)</td>
</tr>
<tr>
<td></td>
<td>Stage 2: Many spreadsheets - Have only ever seen excel being used in the planning process</td>
<td>Stage 3: Stage 2 plus: Sales measured on forecast accuracy - Segment 3: Has procedures in place that enables the measuring, but seldom used in practise</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Information Technology</strong></td>
<td>Stage 2: Some consolidation but done manually - Sales prognosis from individual salesmen are consolidated by their manager and then consolidated again to entire segment.</td>
<td>Stage 2: Individual managers keep own spreadsheets - Managers keep track of their own part of the business but have no overview of the organisation</td>
<td>Stage 2: Some consolidation but done manually -</td>
<td>Stage 3: Revenue or operations planning software - BOND-system for order bookings. (I-plan ERP system currently being implemented.)</td>
</tr>
<tr>
<td></td>
<td>Stage 3: Revenue or operations planning software - Bond, an order planning software with built in customer classification and allocation planning</td>
<td>Stage 2: Many spreadsheets - Most planning and forecasting done in excel</td>
<td>Some spreadsheets collected and consolidated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 2: Many spreadsheets - Most planning and forecasting done in excel</td>
<td>Stage 3: Revenue or operations planning software - ERP system for day-to-day operations and for order bookings. No forecasting in the system</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>S&amp;OP Plan Integration</strong></td>
<td>Stage 3: Bottom up plans tempered by business goals - Sales plan based on budget which is based on projections from individual sales people.</td>
<td>Stage 2: Top-down process - OVERALL ORGANISATION: Sales and operations plans are based on budget which in turn is a top-down decomposition of financial goals/expectations</td>
<td>Stage 2: Sales plan driven operation - Operations uses sales plan to see if it is possible to meet the demand</td>
<td>Stage 2: Capacity utilization dynamics ignored - Sales based on production capacity.</td>
</tr>
<tr>
<td></td>
<td>Stage 3: Some plan integration - Sales adapt plans to planned stops in production</td>
<td>Stage 3: Bottom up plans tempered by business goals - Segment 3: Integrated plans all the way from customers</td>
<td>Stage 3: Some plan integration - Attempts to match sales plan and production plan during annual budget work</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 3: Some plan integration - Sales adapt plans to planned stops in production</td>
<td>Stage 3: Established, monthly process, x month time horizon</td>
<td>Stage 3: Bottom up plans tempered by business goals - Demand planning/factoring at least once a year, bottom-up from sales/customers, updated quarterly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 3: Some plan integration - Sales adapt plans to planned stops in production</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

40
4.5 Credibility

Credibility is a measure used in order to evaluate the quality of an interpretive study (Collis and Hussey, 2009). This section discusses validity and reliability, the two main aspects of research credibility.

4.5.1 Validity

Collis and Hussey (2009, p.64) define validity as “the extent to which the research findings accurately reflect the phenomena under study”. There are a number of possible causes for poor validity in a study, for example faulty research procedures, inaccurate measurement or bad samples. Validity is usually high in interpretivist studies since data is often in the form of detailed explanations, extracted from people directly involved in the phenomena under research. This is very much the case in this study where employees directly involved in an S&OP process were allowed to talk freely during the in-depth semi-structured interviews.

Triangulation is a method which can help to increase the validity of a study (Collis and Hussey, 2009). There are three main types of triangulation; triangulation of theories, data triangulation and investigatory triangulation. Triangulation of theories is the use of a theory from one discipline, used for analysis in a different discipline (Collis and Hussey, 2009). Data triangulation is the process of collecting data, either at different times or from different sources in order to reduce the bias from sources and thereby increase the validity of the findings (Collis and Hussey, 2009). Investigatory triangulation is a form of triangulation where more than one investigator work together in order to reduce the level of researcher bias (Scapens, 1990; Collis and Hussey, 2009).

Data triangulation was used in this study, by conducting 19 interviews with the same interview protocol, along with investigatory triangulation through the collaboration of two researchers.

4.5.2 Reliability

Collis and Hussey (2009, p.64) define reliability as “the absence of differences in the results if the research were repeated”. This definition of reliability is hard to apply to a qualitative study since interpretivists believe that the researcher has an impact on the research. The emphasis in a qualitative study is therefore rather to establish protocols and procedures in order to authenticate observations and interpretations.

A matrix containing an overview of the collected raw data (see appendix IV) and the interview protocol used to collect the data (see appendix III) have therefore been added to the appendix in order to increase the reliability of this study.
4.6 Generalizability

Some methodology researchers proclaim that it is possible to generalise the results of even a single case to another case with a similar setting, thus downplaying the requirement of a large number of observations for generalizability (Gummesson, 1991; Normann, 1970). Consequently, the aim of an interpretivist study is to have a deep enough understanding of the phenomena under study to be able to determine whether the results can be applied to a different setting or not (Collis and Hussey, 2009).

The report should draw out theoretical implications, which will carry over to other case studies. As argued earlier, this does not imply statistical generalisations to some larger population, but theoretical generalisations, which may be helpful in studying other cases (Scapens, 1990).

The nature of case studies implicates that the results, in the form of the maturity level of the case company, cannot be statistically generalised to other companies even in the same industry. Generalizability of this thesis must therefore be considered low, at least in its statistical sense. The role of a single case study, in the context of generalizability, could however be to contribute with material for use in multiple-case studies, with higher generalizability, at a later stage. Further on, as expressed by Yin (2009), a single case study, while not generalizable to a population, is generalizable to a theory and should be considered a way of expanding it. In that sense, this study could still contribute to the generalizability of the investigated theory.

4.7 Ethical aspects

As a case study approach is employed in this study, and data is primarily collected through interviews, there is a specific need for protecting the human subjects participating in the research (Yin, 2009). Collis and Hussey (2009) and Yin (2009) both describe two of the most important ethical principles as being voluntary participation and, anonymity and confidentiality. Voluntary participation implies that people should never be coerced or forced to participate in the study. Nor should they be encouraged to apply by offering financial or other material rewards, as it may lead to biased results. Also, informed consent should be gained by informing subjects of what is required of them, to as large a degree as possible without compromising the purpose of the study, before they consent to participate. Further on, all participants should be given the opportunity to remain anonymous by being offered confidentiality and anonymity. Anonymity can contribute to a sense of security of the respondent and lead to more honest and open responses. On the other hand, it may also erode the credibility of the findings, as the data might seem less relevant when the position of the respondent is not known. Confidentiality can in a similar way lead to more useful responses from participants by promising not to disclose any sensitive information, or by making sure that the participant cannot be identified.
When conducting the interviews in this study the ethical aspects discussed above were carefully considered. For instance, all interviewees participated voluntarily and were informed about the research purpose beforehand. In addition, all interviewees were offered confidentiality and anonymity and measures have been taken in order to make sure that the participants cannot be identified.
5. Results and Analysis

5.1 Grimson and Pyke maturity analysis

In this section, a maturity assessment of the case company using the qualitative approach described in chapter 4 is presented. There are several reasons to conduct this maturity assessment; (1) to, in an inductive manner, identify a method for qualitative maturity level assessment using a maturity model, (2) to identify necessary modifications in order to adapt the general maturity models to the process industry, (3) to, in a deductive manner, test the most comprehensive maturity model identified against empirical observations, and (4) to identify the current maturity level of the case company in order to suggest recommendations for improvement of their S&OP process.

As mentioned above, the Grimson and Pyke (2007) model presented in section 3.3.3 was identified during the initial literature review as the most comprehensive of the maturity models and was therefore also the natural choice for the maturity assessment. It can therefore be helpful to have table 8 in mind while reading the following sections.

5.1.1 Five dimension analysis of the case company S&OP process

Meetings and collaboration

One of the main concepts on the “meetings and collaboration” dimension is that of silo culture, but there is no real explanation of the concept made by Grimson and Pyke (2007). The logical choice is therefore to use the Lapide (2005) interpretation of the concept since the Grimson and Pyke (2007) S&OP maturity model is largely based on the maturity model proposed by Lapide (2005). Lapide (2005, p. 13) describes companies as “siloed” when “departments historically evolved focused on meeting their own goals, at times at the expense of other departments in a company”. This type of isolation of departments and fragmented organisational goals are typical for an organisation with no S&OP (Lapide, 2005; Grimson and Pyke, 2007). Although there are signs of silo mentality in the case company, the problem does not appear to be as severe as described in the literature. For example, operations tries to keep up with, or beat, the volumes set by the production budget, while sales tries to match, or beat, the sales goals set by the budget. However, there are coordinating functions in between the sales and operation functions that continuously work to adapt and coordinate sales to production and vice versa, to avoid siloing (I1; I2; I3; I5; I9; I10; I11; I12; I13; I16, 2014).

When Grimson and Pyke (2007) discuss collaboration within an organisation they emphasise the importance of cross-functional collaboration, and especially between sales and operations.
Insufficient communication between sales and operations can lead to situations where, for example, forecasts are exaggerated by sales in order to secure timely deliveries. These forecasts are then in turn adjusted down by operations, since they have become accustomed of this habit of the sales department (Grimson and Pyke, 2007). Two responses from interviewees suggest some occurrence of such lack of communication within the case company. One respondent describes the existence of “tactical orders” in the supply stage, something that the interviewee however describe as more or less resolved through increased communication and visibility (I6, 2014). Another respondent describes how there is a lack of initiative for sales personnel not to exaggerate their sales forecasts, with the natural consequence of some tactical forecasting to secure production volume (I5, 2014). Grimson and Pyke (2007) proceed to describe how finance in turn might overrun the forecasts of both sales and operations in order to meet the financial targets, without the necessary knowledge of neither the market nor production capabilities, resulting in even less accurate forecasts. Such a focus on financial targets seems highly present in the case company, where the yearly forecasts are budget based and the budget is finalised by the financial officers (I2; I3; I7, 2014). The consequence of this focus on the cross-functional aspect of collaboration is that companies can be classified as having “no collaboration” despite of there being significant collaboration within the separate operations and sales functions.

The respondents present a quite unanimous perception of the collaboration process. There are frequent meetings and well-functioning communication within the separate functions but very little or no cross-functional collaboration between sales and operations, depending on the business area. In business area 1 there are some collaborative initiatives such as having a sales representative present during production morning meetings, and having someone from the business area attending a few production meetings a year (I17, 2014). Both these initiatives are however on a purely informative basis and can therefore not be considered to be S&OP meetings. Both business area 2 and business area 3 describe a similar collaborative process where, when sales and operations functions need to communicate they do so through a manager with a coordinating function, but hardly ever in a direct fashion (I3; I5; I8; I9; I10, 2014).

In much the same way as in the case of collaboration, a company can be placed in stage 1 in the meetings dimension despite having a multitude of meeting platforms. In fact, within the scope of the Grimson and Pyke (2007) model, meetings do not contribute to the maturity of the S&OP process unless they are cross-functional or designed for the specific purpose of S&OP. For example, Grimson and Pyke (2007) describe a company as being in stage 1 in the meeting dimension despite the occurrence of executive meetings, since S&OP is not on the agenda. No responses from the interviewees suggest any occurrence of formal S&OP meetings. Further on, the responses suggest that most meeting structures with planning on the agenda are strictly internal operations- or sales meetings, and most cross-functional meetings are strictly informative (I1; I2; I3; I4; I5; I6; I8; I9; I10; I11; I12; I13; I14; I15; I16; I17, 2014). There are however some cross-functional planning meetings with executive attendance connected to the budget process (I7; I18, 2014), suggesting a slightly more mature S&OP process. Further on,
there is a newly formed initiative of a monthly meeting with planning on the agenda attended by senior vice presidents of each business are as well as supply chain directors (I19, 2014).

Grimson and Pyke (2007) describe a company in stage 3 and above as having enough external cooperation to obtain and use at least some data from the major suppliers or customers in the planning process. This integration of supplier and customer data is important for higher reliability of forecasts which in turn helps to avoid suppliers stocking out on vital components due to large, unexpected orders as well as not being able to deliver orders on time in full to customers (Grimson and Pyke, 2007). There are distinct differences between the three different business areas of the case company when it comes to cooperation with customers. Business area 2 is by far the most developed in this regard. Large customers participate in market intelligence meetings once a month or quarterly and thorough demand prognoses are delivered on a yearly basis (I2; I8; I13, 2014). Further on, a segment of business area 2 has business meetings with customers that, at least to some extent, address planning (I2, 2014), which is a stage 4 requirement (Grimson and Pyke, 2007). Business area 1 tries to obtain prognoses from its key customer every month and use the input in the development of forecasts (I12; I16, 2014). Lastly, business area 3, while having continuous communication and discussions about their beliefs of the future, does not receive any input from customers in the form of figures or prognoses (I11; I18, 2014).

**Organisation**

Grimson and Pyke (2007) describe a stage 2 company on the “organisation” dimension as having no formal S&OP team. Some of the S&OP tasks are however fulfilled by others. A stage 3 company is described as having either no formal team but having the S&OP function as the responsibility of another position such as the supply chain manager, or a formal S&OP team. A stage 4 company is described as having a formal team with executive level participation and clear S&OP responsibilities for all team members (Grimson and Pyke, 2007).

The case company can be described as a stage 3 company on this dimension. Today the company has an S&OP manager, but the company has no formal S&OP team. The S&OP manager does however collaborate with all business areas and people responsible for planning at some of the production units (I3, 2014). There are no other S&OP managers, but some of the duties of the S&OP manager are covered by other positions in other parts of the organisation (I3, 2014). Parts of the S&OP duties are, for instance, covered by allocation managers who serve as the link between production and sales, and continuously try to balance sales and production on an operational level (I5, 2014). The senior management team supports the S&OP initiative, but there is no executive participation (I3; I18, 2014). As there is no formal team or executive participation in the S&OP process the company does not reach stage 4 on the “organisation” dimension, and is therefore considered to be in stage 3.
Measurements

The “measurements” dimension applies to both company performance and how effective the S&OP process is (Grimson and Pyke, 2007). In stage 1, companies have no measurements apart from standard financial accounting measures. In stage 2, companies measure how well operations meet the sales plan. According to Grimson and Pyke (2007) it is usually measured on a quarterly or monthly basis. Stage 3 is a development of stage 2 where, in addition to measuring how well operations meet sales, sales are also measured on forecast accuracy. In stage 4, metrics concerning new product introductions, such as development costs, time to market and ramp-up time are introduced. Moreover, measurements relating to the effectiveness of S&OP beyond standard operational and financial systems are used in addition to the measurements in stages 2 and 3.

The responses to questions regarding measurements differ somewhat between the interviewees but some clear response patterns can be deciphered. Most interviewees on the production side state that the production is monitored on a weekly or even daily basis and compared with the yearly production budget (I15; I16; I17, 2014). Similarly sales personnel state that the sales are monitored frequently and compared to the sales plan, and that the yearly sales plan is updated quarterly (I1; I8; I9; I10; I11; I12; 2014). These notions are supported by people with insight into both sales and production (I3; I4; I5; 2014). However, no interviewee specifically states that the company measures how well operations meet the sales plan.

In the process industry, the annually produced volume is more or less fixed as the machines run non-stop, except during planned stops once a year (see chapter 2 for further information regarding this). Consequently the sales department has more or less a fixed volume to sell annually. The main issue for the company is what product and quality to produce, which largely depends on the market demand. The demand planning process at the case company is largely a bottom-up process starting with the sales department consulting their customers (see S&OP plan integration section below). One respondent explicitly states that the production budget is based on the sales budget (I11, 2014). Others mention that the production budget is constructed taking the sales plan into consideration (I2; I19, 2014). Consequently the production plan can be considered to, at least partly, be based on the sales plan regarding what type of product or quality to produce. One could therefore argue that the case company is in stage 2 on the “measurements” dimension as the company, in a sense, measures how well operations meet the sales plan by measuring and monitoring the production and comparing it to the production budget. The fact that the production volume is more or less fixed in the process industry makes measurements of how well operations meet sales plan slightly less relevant for companies in this industry than for instance companies producing fast-moving consumer goods, thus making the determination of the maturity level on the dimension less straightforward.

According to I2 (2014) there is essentially no systematic way of measuring whether production meets the sales plan in the overall organisation. There is however a business segment, segment 3,
where there are tools in place, making it possible to even measure the accuracy of the sales forecasts, corresponding to stage 3 on the “measurements” dimension. According to I2 (2014) these measurements are however done very sporadically and the tools in place are not utilised in an effective manner. Other respondents specifically state that there is no hit rate on prognoses (I7, 2014), measurements of forecast accuracy (I3, 2014) or formal process to measure the forecast accuracy (I8; I9; I12, 2014).

Many respondents also mention that Key Performance Indicators (KPIs) such as On Time In Full (OTIF) are used to follow the effectiveness of the operations (I4; I6; I9; I10; I13; I16, 2014). In addition a respondent on the production side states that planned production loss is compared with actual production loss during the yearly planned stop at his production unit (I15, 2014). There are consequently elements from stage 4 in place as these measurements can be argued to, to at least some extent, be measurements of the S&OP effectiveness.

To conclude, a majority of the respondents state that both sales and production are measured and compared with sales plan and production budget respectively. As the production budget is partly based on the sales plan, the company could be considered to almost reach the maturity level corresponding to stage 2. There are also some elements from higher stages, for instance tools to measure forecast accuracy, corresponding to stage 3, within at least one business segment. Also some KPIs relating to S&OP effectiveness such as OTIF are measured, which is an element in stage 4. Considering the production dynamics in the process industry, with a more or less fixed production volume regardless of the demand, the overall maturity level of the case company on the measurement dimension is considered to be in stage 2. This despite the fact that no respondent specifically expressed that the company measures how well operations meet the sales plans.

**IT-structures**

IT-structures are described as a useful tool for an S&OP process but not vitally important for the success of it (Grimson and Pyke, 2007). The maturity of the IT-structures does however follow a path from individually owned, decentralised, spreadsheet based structures to centralised, automated and highly visible planning systems (Grimson and Pyke, 2007), and so it is generally true that an increasing level of plan integration requires increasing levels of integrated, centralised and visible IT-structures (Lapide, 2005).

The IT-structures of the case company are quite disperse and dependent not only on business area, but also on production unit. There is one common denominator in that excel is being used in one form or another for planning and forecasting purposes throughout the organisation (I1; I2; I3; I11; I12; I13, 2014). But all in all, no less than 15 different IT-systems were identified in the organisation as a whole throughout the course of the interviews. This dimension has therefore been analysed from the perspective of each separate business area in order to capture the IT-structure disparity within the case company.
Business area 1 mainly uses four types of IT-tools. Sales managers receive sales prognoses in excel from individual sales personnel and consolidate the information before sending it to the director who again consolidates the information for the entire business segment (I1, 2014). Sales plans are received in excel and are then manually loaded into an order handling system for centralisation and accessibility purposes (I16, 2014). One interviewee also describes individually kept spreadsheets amongst sales personnel used to keep track of the order situation (I12, 2014). In the operational process, the order handling system is used for registering orders which are, in turn, loaded into another order handling system to be allocated with regard to customer classification, (I16, 2014) and finally sent to an operations planning software for planning optimal cutting of the paper rolls, also called trimming (I16; I17, 2014). Receiving the sales plan in a spreadsheet is typical for a stage 2 IT-structure while individually kept spreadsheets are signs of a stage 1 IT-structure. The operations planning software and centralised information are on the other hand are both stage 3 characteristics. This would suggest that Business area 1 is currently at a maturity level somewhere in between stage 2 and 3 in the “IT-structure” dimension.

Excel is the only planning tool used in business area 3 (I11, 2014). Much like the case of Business area 1, sales forecasts are fed into a spreadsheet, passed along, and eventually consolidated by the sales manager (I10; I11, 2014). One interviewee does however describe a forecasting system used before the merger that is now only used in a segment of business area 2 (I11, 2014). Further on, one of the interviewees describes an operational planning IT-tool, which enables monitoring and planning of the production with a one week horizon (I15, 2014). Also, there seems to be a more widespread use of excel in the operational planning, in order to handle, for example, planned stops, production pace and buffer development (I15, 2014). As in the case of business area 1, business area 3 fulfil the characteristics of a stage 2 IT-structure in that spreadsheets are consolidated, and stage 3 since some form of operational planning system is implemented. However, since information is not centralised in the same manner, business area 3 should be placed slightly below business area 1, just above stage 2.

Parts of business area 2’s IT-structures are comparable to that of the other business areas. The operational process, for example, is similar to that of Business area 1. Orders are entered into an order handling system and then transferred to an operational planning tool which is used for planning and trimming the production (I13, 2014). Information entered into the order handling and operations planning system is centralised in that it can be reached by anyone, although this is not an automated process (I13, 2014). The two segments of business area 2 are however considerably more advanced in the forecasting IT-structures. Segment 3 has, in addition to the order handling and operational planning tools, an information portal in which one of the segment’s key customers enters a rolling three month demand prognosis every month. Further on, they employ another system for monitoring and including factors such as safety inventory and production cycles into the forecasts (I9, 2014). Segment 4 also employs an IT-tool, which
produces forecasts based on volume and price information. This tool logs prognoses and budgets from previous years as well (I8, 2014). The use of this tool for optimising sales plans with regards to volume and price, together with the operations planning software and centralised information, are all characteristics of a company with a stage 3 IT-structure. Thus, if business area 2 was its own company, it would be in stage 3 in the “IT-structure” dimension.

In addition to the IT-structures used throughout the business areas, there are others utilised by functions outside of these business areas such as finance and wood supply. Wood supply is currently handling and consolidating all planning in excel (I6, 2014). Finance consolidate information from excel as well as the order handling systems to create financial prognoses in a financial controller system (I7, 2014).

**S&OP plan integration**

The “S&OP plan integration” dimension addresses how well a company’s sales and operations plans are constructed and how well the plans are integrated. Grimson and Pyke (2007) argue that the meetings, measurements, organisational changes and IT-structures, discussed above, are all means to the integration of the sales and operations plans. Companies in stage 1 essentially have no S&OP and operations do not receive any sales forecasts in advance, and must simply try to meet incoming orders. In Stage 2 the operations plan is driven by the sales plan. It is a one-way process and no capacity constraints are taken into consideration to adjust the sales plan. Furthermore, in stage 2 plans are created in a top-down process. In stage 3, the process is also mainly one way where sales drive operations, although some operational information may be used to adjust the plans. Unlike stage 2 companies, stage 3 companies also develop forecasts bottom-up and then have them tempered by business and financial goals. In stage 4 the planning process is collaborative rather than driven by sales and capacity constraints are considered in both directions.

The perception of the S&OP plan integration varies among the respondents. Some personnel on the production side do not mention any plan integration or plans of any kind, but rather a process where operations try to meet incoming orders (I14; I17, 2014). This perception corresponds to stage 1 on the dimension. Another interviewee describes a planning process of the overall company that is believed to be a decomposition of financial goals and expectations, corresponding to the top-down process described in stage 2 (I2, 2014). The same interviewee does however argue that one segment, segment 3, has integrated plans from customers, an established monthly process for the plan integration corresponding to bottom-up plans, and some integration, corresponding to stage 3. In addition the interviewee indicates that the planning process in the segment is concurrent and that the S&OP manager and finance sit down to discuss whether or not supply plans are reasonable (I2, 2014), corresponding to the collaborative and concurrent process described as an element in stage 4.
The majority of the respondents describe a bottom-up process for plan generation. According to I7 (2014) the business plan, which is the basis for the financial budget, uses demand input along with the sales plans from the sales organisation (I7, 2014). Similarly all interviewed representatives from the sales organisation, regardless of business area, describe a sales forecasting process based on customer input and the input from individual sales personnel (I1; I8; I9; I10; I11; I12, 2014). The customer involvement does however differ between different segments. For instance, segment 3 consists of a few large customers and so the customer input during the demand planning process is more developed within this segment than within other segments with a large number of different customers (I18, 2014). The sales forecast is generally generated during the budget process for the upcoming year, and then updated quarterly or monthly. The forecast generation approach is confirmed by employees in allocation roles between production and sales, as well as by a senior manager (I3; I5; I8; I18, 2014). Furthermore, one respondent adds that the bottom-up forecasts are tempered by business goals, for instance if one product segment is more profitable, volumes of another less profitable segment might be reduced in response (I11, 2014), attesting that the case company is currently in stage 3 on the integration dimension.

According to a majority of the respondents, there is some integration of the sales and production plans as well. Some respondents highlight that the sales plans are especially adapted to the planned production stops (I1; I12; I15, 2014). Others emphasise attempts to match sales plans and production plans during the annual financial budget process (I3; I4; I7, 2014). Another respondent argues that the sales plan is never unreasonable in relation to the production capacity, but that it is not optimised to it either (I5, 2014). Many respondents on the sales side of the organisation argue that the integration of plans is performed by the S&OP manager or personnel in other allocating roles (I7; I8; I9; I10; I11, 2014). Many respondents also reject the notion that capacity utilisation dynamics are ignored by stating that sales plans are adapted to allocation decisions (I4; I9; I10; I11; I12, 2014), which would indicate that the company has passed stage 2 with respect to the capacity utilisation element. Other respondents, especially among those in production planning roles, do however experience that sales plans drive operations, especially in the day-to-day operations (I3; I13; I15; I16, 2014). It is however not entirely a one-way process as the production plan contains some restrictions to the different sales offices (I16, 2014). However, as discussed above, the production volume in the process industry is more or less fixed. Therefore, the production decisions mainly concern what type of paper, board or quality to produce rather than what volume to produce. It is consequently important to keep this context in mind when analysing the answers regarding how production are attempting to meet the sales plan.

In conclusion, taking all the different answers into consideration, the overall organisation of the case company is considered to be in stage 3 on the “S&OP plan integration” dimension. The majority of the respondents, regardless of business area, describe forecasts as developed bottom-up from sales with input from customers. Most respondents also describe some plan integration
and how some restrictions are considered when attempting to match the production and sales plan. Some interviewees mean that operations are solely attempting to meet incoming orders and others argue that the sales plans drive operations, corresponding to stages 1 and 2 on the integration dimension. The respondents with this view are however mainly personnel with production planning roles describing how they, on a daily basis, are attempting to allocate incoming orders to the different machines. There is however, based on other responses, no doubt that the production capacity is considered when constructing the sales budget. Many respondents state specifically that capacity utilisation dynamics are not ignored, which indicates that the company is past stage 2 on the dimension. Some respondents also mention elements from stage 4 such as the process being concurrent and collaborative as well as some constraints (type of product or quality produced) being applied in both directions, at least within some sub-segments.

The S&OP integration process consequently has elements from stages 2-4, with the majority of the elements from stage 3, making the overall assessment on the integration dimension stage 3.

5.1.2 Summary

Overall, there are no formal S&OP meetings and very little cross-functional collaboration between sales and operations. In fact, only business area 1 seems to have such an initiative in place with sales and business area representatives present during some production meetings. This corresponds to a stage 1 process on the “meetings and collaboration” dimension. The focus on financial goals and the fact that S&OP is discussed to some degree in top-level management meetings do however move the maturity level towards stage 2. Finally, the fundamental difference between the business areas, and the stage they are placed in, is mainly a result of the level of customer collaboration. Business area 2 has, in some regards, reached a customer collaboration normally found in stage 4 and is thus placed in a higher stage than the other business areas. All things considered, business area 1 is placed in stage 2, business area 2 in stage 2.5 and business area 3 in stage 1.75, while the overall organisation is placed in stage 2.5.

The S&OP organisation is the same for all business areas with one formal S&OP manager responsible for the entire organisation, and without a formal S&OP team backing him up. Since there is a formal S&OP manager, but no team nor any executive participation, the overall organisation is placed in stage 3 on the “organisation” dimension.

A majority of the respondents, regardless of business area, state that both sales and production are measured and compared with sales plan and production budget respectively. As the production budget is partly based on the sales plan, the company could be considered to reach the maturity level corresponding to stage 2 on the measurement dimension. Since tools are in place to measure forecast accuracy in one of the segments within business area 2, the business area is considered to have reached a slightly higher level of maturity than the other two. The overall maturity level of the case company on the measurement dimension is however considered to be in stage 2.
All business areas employ some form of operations planning software. While business area 1 and business area 3 are still highly dependent on excel for their planning processes, business area 2 employ an IT-tool used for integration of customer data as well as the use of price and volume information to generate forecasts. This tool has resulted in a move away from excel based planning, towards what resembles revenue planning and centralisation of information. Lastly, business area 1 does put some effort into centralising information, while this does not seem to be the case in business area 3, placing the former in a slightly higher stage than the latter. For these reasons business area 3 is placed in stage 2.25, business area 1 is placed in stage 2.5 and business area 2 in stage 3.

Most of the respondents, regardless of business area, describe that forecasts are developed bottom-up from sales with input from customers. Most respondents also describe some plan integration, and that certain restrictions are considered when attempting to match the production and sales plan, corresponding to the majority level of stage 3. One respondent does however indicate that business area 2 has a concurrent and collaborative integration process corresponding to one of the elements of stage 4. Business area 2 is therefore considered to have a slightly higher maturity level than the other business areas. It is however not high enough to increase the overall level of maturity above stage 3.

When taking all the different S&OP dimensions into consideration, the maturity levels differ somewhat between the different business areas within the company. Business area 2 reaches the highest maturity with a mean of 2.8. Business area 1 reaches the second highest level of maturity at 2.5, closely followed by business area 3 at 2.4. The maturity level of the overall company is determined to 2.5. The results are summarised in table 13 below.

Table 13. Summary of case company maturity level.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Meetings and collaboration</th>
<th>Organisation</th>
<th>Measurements</th>
<th>IT-structures</th>
<th>Plan integration</th>
</tr>
</thead>
<tbody>
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<td>3</td>
<td>2</td>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
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<td>2</td>
<td>2.5</td>
<td>3</td>
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<td>-</td>
<td>2.25</td>
<td>3</td>
<td>3.25</td>
</tr>
<tr>
<td>Business area 3</td>
<td>2.4</td>
<td>1.75</td>
<td>-</td>
<td>2</td>
<td>2.25</td>
<td>3</td>
</tr>
</tbody>
</table>

### 5.1.3 Discussion regarding interview answers

During the interviews it became apparent that a large number of IT-systems are used in the case company. The systems differ between business areas but also between different production units within the different business areas. No less than 15 different IT-systems were identified through the interview process. The vast number of systems is likely due to the many mergers and
acquisitions carried out by what would eventually become the case company (see background section 2.2). With the large number of different systems it is naturally difficult to achieve centralized and coherent information. Consequently it is challenging for large companies, frequently acquiring new production units, to reach a high maturity on the “information technology” dimension, as it is both costly and time consuming to integrate established systems.

The answers among the respondents regarding some of the dimensions, and especially regarding some of the elements within the dimensions, differ significantly. For instance some of the respondents describe a top-down planning process, whereas the majority describe that plans are generated bottom up. This may be due to the limited contact some personnel have with the sales force whose prognosis form the basis in the demand planning process, which in turn is described to be the base of the budget planning process. Similarly some respondents, mainly from the production side, describe that sales drive operations and that production simply try to meet incoming orders without any plan integration to speak of. Other respondents do however describe that there are integrating functions and that some plan integration is done during the annual budget process. The impression that there is no plan integration and that production simply is trying to meet incoming orders is likely due to the fact that the respondent in question is not personally part of or aware of any existing integration processes.
5.2 Expanded and adapted maturity model

The aim of this section is to develop an expanded maturity model adapted to the process industry. Section 5.2.1 describes the expansion of the model made and the reasoning behind it, while section 5.2.2 explains any adaptations made in order to better align the model with the conditions of the process industry. Finally, the expanded and adapted maturity model is presented in its entirety in section 5.2.3.

5.2.1 Model expansion

Planning horizons

As concluded in section 3.2.7, there is no real consensus in the current state of research regarding the preferred length of S&OP planning horizons, but there is no doubt that it is an integral parameter of the S&OP process. While there is lack of consensus, there are common requirements stated by S&OP field researchers. These researchers argue that planning horizons should be long enough to: (1) Support the annual business plan (Thomé et al, 2012; Affonso et al., 2008), (2) capture seasonality (Grimson and Pyke, 2007; Fleischmann et al., 2002), (3) include supply/production/delivery lead time (Affonso et al., 2008; Grimson and Pyke, 2007), and (4) support resourcing decisions (Olhager, 2013; Thomé et al., 2012). To be able to support the annual business plan and budget, the planning horizon should be at least one year long, and in order to capture seasonality at all times, the planning horizon needs to be longer than 12 months (see section 3.2.7 for explanation). For the same reason, the planning horizon needs to be longer than 12 months in order to fully cover the effects of planned stops, something very essential and specific to the process industry (see section 2.1 for further discussion regarding planned stops). With this in mind, it is logical to divide the planning horizons into three cases: (1) Planning horizon too short to support the annual business plan, (2) planning horizon long enough to support annual business plans but too short to account for planned stops and seasonality at all times, and (3) planning horizon long enough to take planned stops and seasonality into account at all times. These three cases can then be placed into the stages of the maturity model. The first case has a set planning horizon and thus also some form of basic S&OP process in place. For this reason, the first case should be placed in stage 2 of the maturity model rather than stage 1. The second case is long enough to support the annual business plan, but not long enough to account for seasonality and planned stops at all times, and should hence be no shorter than, but approximately, 12 months long. As this planning horizon is somewhere in the middle of the intervals identified in section 3.2.7, it is reasonable to place it in the third stage. The third case is long enough to always account for planned stops and seasonality and should therefore, for reasons further developed in section 3.2.7, be at least 18 months. It should therefore be placed in stage 4 of the maturity model, since the fifth stage represents a utopian, or at least extremely hard to reach, S&OP process.
Inventory management

Efficient inventory management reduces working capital by minimizing inventory stock, which leads to increased revenue, efficiency, and customer service (Viswanathan, 2008). Viswanathan (2010) reports that 38 per cent of best-in-class companies actively try to reduce working capital through inventory reduction and states that closed loop inventory management is a requirement to have a best-in-class S&OP process. Since many best-in-class companies have this type of inventory management in place, it cannot be considered utopian and should therefore be placed in the fourth stage of the maturity model rather than in the fifth stage. Closed loop inventory management is however a quite advanced type of inventory management (figure 4 illustrates the key events and metrics involved in a closed loop inventory management process, see Viswanathan, 2008 and 2009b for further information), thus, in order to include the positive effects of less advanced forms of inventory management, another criterion called “some inventory management” is included in the third maturity stage of the model.

![Diagram of closed loop inventory management]

Figure 4 Components of closed loop inventory. Events are shown in outer most circle and metrics in the innermost circle (Viswanathan, 2008).

Meeting attendance

Lapide (2005) has meeting attendance as one of the main criteria in his “meeting structure” dimension. The meeting structure dimension is in many ways very similar to the “meetings and
collaboration” dimension of the Grimson and Pyke (2007) model (see maturity model comparison in section 3.4). It is therefore reasonable to place meeting attendance in the “meetings and collaboration” dimension. Meeting attendance is divided into two cases: (1) spotty attendance and participation, and (2) 100% attendance and participation. The first case, “spotty attendance and participation”, is found in stage 2 of the Lapide (2005) maturity model. The second maturity stage of Lapide (2005) corresponds to a rudimentary process, which could correspond to both stage 2 and stage 3 of the Grimson and Pyke (2007) model. It can however be argued that there must first exist a developed meeting process in order for attendance to be meaningful. With this reasoning, the first case is placed in stage 3 since it is the first stage with a developed process in place. The second case, “100% attendance and participation” is found in stage 3 of the Lapide (2005) maturity model. This stage is just below the final, utopian, stage of the Lapide (2005) model, and would thus correspond to stage 4 of the Grimson and Pyke (2007) model. Hence, the second case is placed in the stage 4 of the “meetings and collaboration” dimension.

Knowledge management

There already exists a criterion for the organisational understanding of S&OP in the “organisation” dimension of the Grimson and Pyke (2007) maturity model. This criterion states; “throughout the organisation, S&OP is understood as a tool for optimising company profit” and does thus only regard the understanding of S&OP as a tool for optimising company profit. Viswanathan (2010) on the other hand goes beyond this with the two criteria identified from the “knowledge management” dimension (see section 3.4.2). The first criterion; “the organisation utilise statistical analysis and fact based decision making”, refers to the utilisation of S&OP methods in the decision making process. The second criterion, “organisational understanding of business systems”, refers to the understanding of implemented S&OP information technology. Hence, both criteria refer to the overall understanding and utilisation of fundamental S&OP systems and processes, and are therefore merged into the one criterion; “all S&OP systems and processes are understood and utilised throughout the organisation”. Since these are considered best-in-class criteria by Viswanathan (2010), and because the very similar criterion of the Grimson and Pyke (2007) model, described above, is placed in stage 5; the new criterion should be considered a very advanced criterion, and is hence placed in stage 5 as well.

Information technology

A majority of the maturity models described in section 3.3 encompass information technology in one form or another. Wing and Perry (2001) advocate that models in the IT-system should reflect third party constraints. This aspect is not covered in the maturity model of Grimson and Pyke (2007). Grimson and Pyke (2007) discuss constraints within the scope of the “S&OP plan integration” dimension but they do however only mention internal constraints. In stage 4 constraints are applied in both directions, from sales and production (Grimson and Pyke, 2007).
It is therefore reasonable to place third-party constraint considerations as an element in stage 5 on the integration dimension.

In their “technology” dimension Ventana Research (2006) promote the use of metrics and emphasise the importance of assigning accountability for tasks and measurements to individuals. This is a natural development of the stage 3 element “sales measured on forecast accuracy” in the “measurements” dimension in the maturity model of Grimson and Pyke (2007). It is therefore logical to add the element “assign accountability for tasks and measures to individuals” to stage 4 on the “measurements” dimension.

5.2.2 Model adaptation
Planning strategies reflect the choice of trade-off between capacity, inventory and backlog, made in order to satisfy demand in the most profitable way possible (Chopra and Meindl, 2013). The primary planning strategies are level, chase and mix strategy (Olhager et al., 2001; Chopra and Meindl, 2013). According to Olhager et al. (2001) the process industry often implements a pure level planning strategy. A level planning strategy leads to a stable machine capacity utilisation and workforce, while change in demand has to be absorbed by changes in inventory levels and, or, changes in the order backlog (Olhager et al., 2001; Chopra and Meindl, 2013). Absorbing changes by changing inventory levels is a common tactic in a make-to-stock environment while changing the order backlog is a more common tactic in a make-to-order environment (Olhager et al., 2001). Regardless of environment however, the level strategy has a strong focus on resource utilisation and thus aims to keep changeover costs and costs related to changing capacity to a minimum (Olhager et al., 2001; Chopra and Meindl, 2013; Fransoo and Rutten, 1994).

In addition, process flow process production is often implemented in the process industry, meaning that production runs continuously with minimal interruptions (Fransoo and Rutten, 1994; Abdulmalek et al., 2006; Taylor and Bolander, 1995; Fransoo, 1992). Moreover, Carlsson et al. (2009) state that capacity utilisation in the paper industry is very high. The tendency towards implementation of process flow production and a pure level strategy has a profound implication on two elements in the maturity stage 2 on the “S&OP plan integration” dimension: “capacity utilisation dynamics ignored” and “sales plan drives operations”. The pure level strategy causes the capacity utilisation to be kept stable which means that there are no capacity utilisation dynamics. This has the natural consequence that there are no capacity utilisation dynamics to ignore, thus making the element irrelevant. Similarly, sales plans can never truly drive operations when a pure level strategy is implemented. The reason being that operations are focused on keeping a stable production decoupled from forecasts and actual market demand, (Olhager et al., 2001; Chopra and Meindl, 2013) meaning that production volumes are never adapted to the sales plan. With this reasoning, the “sales plan drives operations” element must also be considered irrelevant for the process industry.
Another element in need of adaptation is the “constraints applied in both directions” element from the fourth stage of the “S&OP plan integration” dimension. The reason for this is that operations always constraint sales in a level production strategy setting, while constraints applied from sales on operations are very limited (Olhager et al., 2001; Chopra and Meindl, 2013). The exception for this is when there exist flexible production facilities capable of producing a variety of products, in which case sales may affect what is produced at what time. There are however further constraints as to what can be produced at what time, and in what order, in these facilities due to changeover costs and changeover times (Fransoo, 1992). Thus, even though sales can apply constraints on operations in some settings of the process industry, the impact is very limited compared to other industries. The element in its current form is therefore all together considerably less relevant in a process industry setting than in a general setting. An adaptation of the element is therefore suggested as: “Constraints applied from operations to sales, and if applicable: production cycles influenced by constraints applied from sales”.

Further on, the element “measures how well operations meets sales plan” in stage 2 of the “measurements” dimension becomes less relevant in the process industry for the above reasons. That is, since operations in a company with a pure level strategy are trying to keep a constant capacity utilisation, they should be measured on how well they meet the capacity utilisation level rather than the sales plan. However, as in the case with the “constraints applied in both directions” element, there is an exception when there are multi-product production facilities. In this case, operations could be measured on how well they meet the production cycle plans as well. With this reasoning, the mentioned element is changed to; “measures how well operations meets capacity utilisation targets and, if applicable, how well operations meets production cycle plans”.

5.2.3 Finalised maturity model
The finalised maturity model is largely based on the Grimson and Pyke (2007) maturity model. It has however been expanded with elements from the other maturity models (see section 5.2.1), identified from literature (see section 3.4), and then adapted to the process industry (see section 5.2.2). The finalised maturity model can be viewed in table 14. Elements that have been added to the model are shown in bold while elements that have been adapted to the process industry are written in italics. Elements deemed irrelevant, as part of the adaptation to the process industry in section 5.2.2, have been removed and can thus not be viewed in the finalised maturity model.
Table 14. Finalised maturity model, expanded and adapted to the process industry.

<table>
<thead>
<tr>
<th></th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Stage 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No S&amp;OP Process</td>
<td>Reactive</td>
<td>Standard</td>
<td>Advanced</td>
<td>Proactive</td>
</tr>
</tbody>
</table>
| 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  
- Spotty attendance and participation | - Supplier & customer data incorporated  
- Suppliers and customers participate in parts of meetings  
- 100% attendance and participation | - Event driven meetings supersede scheduled meetings  
- Real time access to external data |
| Organisation | - No S&OP organisation | - No formal S&OP function  
- Components of S&OP are in other positions | S&OP functions is part of other position: Product Manager, Supply Chain Manager | - Formal S&OP team  
- Executive participation | - Throughout the organisation, S&OP is understood as a tool for optimising company profit  
- All systems and processes linked to S&OP are understood and utilised throughout the organisation |
| Measurements | - No measurements | - Measures how well operations meets capacity utilisation targets and, if applicable, how well operations meets production cycle plans | - Stage 2 plus:  
- Sales measured on forecast accuracy | - Stage 3 plus:  
- New product introduction  
- S&OP effectiveness  
- Assign accountability for tasks and measures to individuals | - Stage 4 plus:  
- Company profitability |
| Information Technology | - Individual managers keep own spreadsheets  
- No consolidation of information | - Many spreadsheets  
- Some consolidation but done manually | Centralised information  
- Revenue or operations planning software | - Batch process  
- Revenue and operations optimisation software link to ERP but not jointly optimised  
- S&OP Workbench | - Integrated S&OP optimisation software  
- Full interface with ERP, accounting, forecasting  
- Real-time solver |
| S&OP Plan Integration | - No formal planning  
- Operations attempts to meet incoming orders | - Top-down process  
- Planning horizon not long enough to support budget process | Some plan integration  
- Bottom up plans tempered by business goals  
- Some inventory management  
- Planning horizon support budget process | Plans highly integrated  
- Concurrent & collaborative process  
- Constraints applied from operations to sales, and if applicable: production cycles influenced by constraints applied from sales  
- Closed loop inventory management  
- Planning horizon long enough to always take planned stops and seasonality into account | - Seamless integration of plans  
- Process focuses on profit optimisation for whole company  
- Models reflect third party constraints |
5.3 Recommendations to case company

In this section, the recommendations to the case company are presented and discussed. These recommendations are based partly on the maturity assessment presented in section 5.1, and partly on the expanded and adapted maturity model developed in section 5.2.

5.3.1 Meetings and collaboration

Introduce a formal S&OP process

A formal S&OP process should be implemented as early on as possible. As described in 3.2 there is no true consensus on the number of steps included, but we recommend a process in the lines of the five step process outlined in table 5. Further on, it is important to implement formal S&OP meetings on a regular basis (Thomé et al, 2012; Ventana Research, 2006; Grimson and Pyke, 2007). The trend in S&OP today is towards an increased meeting frequency where the S&OP process is converging towards real-time (Lapide, 2004a; Thomé et al., 2012; Hahn et al., 2000; Slone, 2004; Grimson and Pyke, 2007). As a first implementation however we recommend to strive for monthly meetings with high priority in order to achieve high participation. Although literature describes very elaborate meeting processes with up to five consecutive meetings, we recommend a process with at least one preparatory meeting followed by an executive S&OP consensus meeting. The preparatory meeting should be between sales and operations where their unconstrained plans are presented and discussed followed by an executive S&OP meeting where a consensus plan is reached between all participants of the S&OP team. Once an S&OP process is decided upon, it could be a good idea to start the S&OP process implementation with one pilot product family or segment, as suggested by Grimson and Pyke (2007). They suggest the choice of a relatively low complexity product family but with high business importance so that the effect of the process on plans and financial performance is fully appreciated.

Improve collaboration

While the implementation of S&OP requires a change in the business process, the importance of adapting the company culture accordingly should not be underestimated (Grimson and Pyke, 2007). Historically siloed functions need to start working towards a common goal, with aligned incentives and to understand the importance of supply chain plan integration (Lapide, 2005; Grimson and Pyke 2007; Ventana Research, 2006). This should be achieved by giving employees the necessary S&OP training to understand the process and its importance for profit optimisation (Viswanathan, 2010; Grimson and Pyke, 2007). As a result, we recommend companywide information about S&OP and relevant training of all managers involved in the S&OP process.
Incorporate customer and supplier data in planning process

It is very desirable to include customer and supplier input into the planning process to as high a degree as possible in order to increase the visibility and accuracy of information used throughout the planning process (Chopra and Meindl, 2013; Lapide, 2004b; Cecere et al., 2009). The most important customers and suppliers could even be included in parts of S&OP meetings in order to further increase cooperation and visibility throughout the supply chain (Grimson and Pyke, 2007). While this is close to impossible to implement in some of the product segments with very numerous customers, other segments with fewer and larger customers have great potential, and have to some degree already initiated similar processes. It is however important not to include the customer input on routine, but to be critical and measure the accuracy of the supplier and customer forecasts as would be done with any internal forecasts. It could be worth looking into processes such as sharing Point of Sales data (POS), vendor managed inventory (VMI), Collaborative Planning, Forecasting and Replenishment (CPFR), at least with large customers and suppliers (Lapide, 2004b; Chopra and Meindl, 2013).

5.3.2 Organisation

Formal cross-functional S&OP team

Many researchers emphasise the importance of having a formal cross-functional S&OP team, with involvement from executive management, finance, demand-side managers from sales, customer service, and marketing, as well as supply-side managers from manufacturing, logistics, procurement, and supply chain (Cecere et al., 2009; Grimson and Pyke, 2007; Ventana Research, 2006; Lapide, 2004a). Grimson and Pyke (2007) advocate that an S&OP implementation should begin with putting an S&OP team in place. We therefore recommend the formation of an S&OP team as early on in the process as possible. The team should be cross-functional with participants from supply chain management, sales, production and finance.

Executive involvement

Research indicates that companies with executive engagement have more successful S&OP implementations than companies with no executive involvement (Ventana Research, 2006). Other authors also stress the importance of executive participation and support (Grimson and Pyke, 2007; Cecere et al., 2009; Lapide, 2004a). Lapide (2004a) emphasises the importance of an empowered S&OP team. If senior managers do not participate in S&OP meetings, the participants need to be empowered by the executive team to make decisions on their own beliefs. We therefore suggest executive involvement in the S&OP process, either through direct participation or through empowering an S&OP team and supporting their decisions.
5.3.3 Measurements

Measure forecast accuracy

Several researchers stress forecast accuracy as a key metric of S&OP (Grimson and Pyke, 2007; Cecere et al., 2009; Ventana, 2006). Even though forecasts are always wrong (Chopra and Meindl, 2013), it is important to identify bias in forecasts, that is, forecasts that have a tendency to be constantly over- or under-estimated. Similarly Wallace and Stahl (2008) state that it is important to measure the accuracy in order to identify the assumptions that made the forecast go wrong and thereby, hopefully, prevent them from reoccurring. We consequently suggest starting the measurement of forecast accuracy.

Measure sales on forecast accuracy

There is a lack of initiative for sales personnel not to exaggerate their sales forecasts (I5, 2014). Grimson and Pyke (2007) argue that sales should be measured on forecast accuracy in order to increase the accuracy and thus allowing operations to work with more accurate figures in their planning, and ultimately increasing overall efficiency. We therefore recommend that the case company starts to measure sales on forecast accuracy.

Assign accountability for tasks and measures to individuals

Ventana Research (2006) advocates assigning accountability for measures and tasks to individuals. This is one way of reducing tactical sales forecasting and unjust allocation decisions. We recommend that the case company start to assign accountability of sales forecasts and production plans to individuals.

New product introduction

Grimson and Pyke (2007) advocate the use of measurements related to new product introductions such as; development cost, time to market, ramp-up time, and number of successful introductions. It is recommended that the case company implements these measures when developing and introducing new products.

Measure S&OP effectiveness

Based on S&OP literature, we recommend measuring the effectiveness of the overall S&OP process itself. (Grimson and Pyke, 2007; Viswanathan, 2010; Ventana Research, 2006) OTIF and forecast accuracy are two important measures that should improve with an effective S&OP process and could thus be used as measurements (Grimson and Pyke, 2007; Viswanathan, 2010). Also, 360-degree feedback from team members regarding their participation in the S&OP process should be collected and analysed along with feedback from suppliers and customers.
involved in the process (Grimson and Pyke, 2007). The 360-feedback could for example include factors such as meeting preparedness, meeting attendance, action plan follow up and meeting efficiency (Ventana Research, 2006).

**Measure operations on production cycles set by sales plan**

As discussed in section 5.2.2, it is significantly less relevant to measure how well operations meets the sales plan in the process industry than other industries. The sales plan does however affect the production units that change between products and qualities. Our recommendation is hence to instead measure how well operations meets the production cycles set by the sales plan.

**Proper use of metrics**

Cecere et al. (2009) state that a common mistake among companies is the use of too many metrics. Grimson and Pyke (2007) suggest that it is helpful for managers to list all measures currently used in the organisation and then consider if any measurements should be added or eliminated. In this process, management should specifically consider whether the measurements drive a desired behaviour or not. We recommend the case company to adopt this approach as some interviewees mentioned the use of numerous measures.

**5.3.4 Information technology**

**People and processes first**

An S&OP process often becomes unmanageable without information technology. IT is simply a tool to support the S&OP process; necessary, but not sufficient, for a good S&OP process (Lapide, 2004b). According to Grimson and Pyke (2007) it is more important to have a good S&OP process than elegant software. Simple spreadsheets can be sufficient in the early stages of S&OP and more advanced technology can be introduced once the scope of S&OP outgrows the spreadsheet approach (Grimson and Pyke, 2007, Lapide, 2005). Similarly Ventana Research (2006) found that the main reason for dysfunctional S&OP is silo planning and not IT resources. We therefore recommend putting more effort into the implementation of S&OP structures than in S&OP IT-systems early on in the implementation process.

**Centralised information**

One of the main functions of IT tools is centralised information (Grimson and Pyke, 2007; Lapide, 2005). For more centralised information and ultimately a better S&OP process the demand-side and supply-side software should be integrated as final demand and supply plans should be developed jointly (Lapide, 2005). We therefore suggest that the case company discard the use of spreadsheets to the extent deemed possible and centralise all information, thus making it accessible to all involved parties. Once a formal S&OP process has been established, we recommend considering implementation of ERP, S&OP workbench and APS systems.
5.3.5 S&OP plan integration

Planning horizon

As discussed thoroughly in section 3.2.7, planning horizons should be no shorter than the annual business plan, and at least long enough to always take planned stops and seasonality into account. Based on this, we recommend a planning horizon between 12-18 months, depending on the duration of planned stops and effect of seasonality on case company.

Build plans from the bottom up and integrate plans in a concurrent and collaborative process

The final recommendation is pretty much a summary of previous recommendations. Demand should be developed bottom up, based on prognoses from sales and customer input. The demand plan should then be integrated with the supply plan by applying constraints in both directions. Finally, a consensus plan should be agreed upon through a concurrent and collaborative process in the S&OP team.

5.4 Ten-step process for maturity model analysis with a qualitative approach

In this section, a ten-step process for assessing the S&OP maturity level of a company using maturity models with a qualitative approach is presented. This ten-step process is based on the approach developed through the course of the study in order to assess the maturity level of the case company. A qualitative approach is in this case regarded as an approach based on qualitative data collected through interviews.

The different responses and perspectives among the interviewees in this study (see section 5.1.3), in addition to the naturally limited insights of personnel in some roles, show the importance of interviewing people with different roles, and from different parts of the organisation, to form a comprehensive and general picture of the maturity level of a company. It is therefore necessary to conduct a number of interviews associated with each of the subgroups in order to capture a full picture of the S&OP process within the organisation. We recommend an interview with at least one employee from each of the following positions:

- Sales
- Production
- Supply chain management
- Finance
- Management team
• S&OP team (if it exists)

Members of the sales organisation should be interviewed in order to capture potential collaboration with customers and production, as well as to identify the way in which demand prognoses are developed. Also, if sales forecasts are conducted, interviewees should be asked if the accuracy of the forecasts is actively measured. Production is important to interview in order to determine the level of collaboration with suppliers, as well as if, and in that case how, operational plans are formed. Furthermore, production is most likely to be able to accurately describe any operations planning software structures. Finance needs to be interviewed in order to determine their part in the development of plans and to what degree the plans are focused on financial goals. Further on, finance is most likely best suited to answer whether there is any revenue planning IT-structures, and could also be able to describe the existence of some relevant S&OP measures, such as company profitability. Members of the management team are highly relevant to interview in order to identify whether S&OP is discussed at top level management meetings and how empowered the S&OP team is (if applicable). Finally, if an S&OP team exists, they are naturally best suited to answer any questions regarding the composition of the S&OP team, as well as the existence and structure of potential S&OP meetings.

Below, a ten-step process for assessment of S&OP maturity level through the use of maturity model is presented:

1. Map company
   a. Company type, e.g. manufacturer, retailer etc.
   b. Number of subunits, i.e. units with a distinct and independent structure within the company
   c. Identify relevant subunit functions, e.g. purchasing, production, sales, finance etc.
   d. Identify relevant overall company functions, e.g. finance, SCM, management team etc.
2. Identify interviewees
   a. Should encompass at least one interviewee from each identified function from each of the identified subunits
   b. Should encompass at least one interviewee from each of the identified overall company functions
3. Prepare interviews
   a. Contact interviewees and schedule interviews
   b. Prepare interview protocols
4. Conduct interviews
5. Transcribe interviews
6. Reduce data
   a. Delete obviously redundant and irrelevant data, but save an original transcript
7. Restructure data according to dimensional properties
a. E.g. through colour mapping interviews after model dimensions

8. Map data to maturity model
   a. Connect statements to elements of the maturity model e.g. in an excel matrix

9. Compile data
   a. Look for contradictory statements and assess the credibility of the sources, i.e. sales
      making statements about the production process and vice versa
   b. Look for patterns and validate them through triangulation
   c. Compile validated statements into one set of elements

10. Rank the level of maturity of the company
    a. Rank the maturity level of the company for each dimension
    b. Obtain the maturity level of the company by averaging the level of the dimensions

Formulas for calculating the expected time consumption of a maturity assessment can be found in appendix VII.
6. Conclusion

In this chapter the results of the study are summarised, the contributions of the study are stated, and the limitations are discussed. Finally some suggestions for future research within the field are presented.

6.1 Summary of results

The purpose of this study was to; (1) evaluate S&OP maturity models through comparative analysis and application on a company in the process industry, (2) develop a maturity model suitable for the process industry, (3) suggest a method for using it, and (4) add to the limited number of case studies describing the S&OP process of companies in different industries.

S&OP maturity models can be divided into dimensions and elements. The Grimson and Pyke (2007) maturity model has, through the process of triangulation, been identified to be the most encompassing of the, from theory, identified maturity models. The five dimensions of the Grimson and Pyke (2007) maturity model are; (1) “meetings and collaboration”, (2) “organisation”, (3) “measurements”, (4) “information technology” and (5) “S&OP plan integration”. This maturity model has therefore been used as a foundation for the comparative analysis of the total set of maturity models. The comparative analysis generated a more comprehensive maturity model with elements from other maturity models. This comparative analysis combined with a qualitative maturity analysis of a company in the process industry generated a new maturity model, especially adapted for S&OP maturity assessment in the process industry. The flow production process and level planning strategy, often employed in the process industry (Fransoo and Rutten, 1994; Olhager; 2001), were found to be the main drivers for an adapted model for the process industry. The extended and adapted maturity model is summarized in table 14.

Further on, a complete description of a ten stage qualitative process for a successful maturity level assessment has been proposed along with an equation to help estimate the workload associated with such a process (see section 5.4).

Finally, the maturity level of a company in the process industry has been assessed as a part of the maturity model evaluation and development. The overall maturity level of the company was determined to be 2.5 on scale from 1 to 5, using the framework of Grimson and Pyke (2007). The maturity level did however differ slightly between the company’s different business areas. Similarly the maturity level on some dimensions was found to be higher than on others. Based on the maturity assessment recommendations have been made to the case company (see section 5.3), illustrating the practical usefulness of the maturity model.
6.2 Contributions

Evaluation of existing maturity models and their suitability to different industries, along with descriptions of suitable methods for using them, is very limited or non-existent in the current state of research within the field of S&OP research. This study contributes to the current state of research by evaluating existing S&OP maturity models and by suggesting a method for using them in a case study context.

In addition, as none of the existing maturity models are developed for specific industries or consider certain industry characteristics, this study has resulted in the development of a maturity model especially adapted for application in the process industry (see table 14).

Moreover, there has been an expressed lack of case studies describing the S&OP process in different industries and cultures (Thomé et al., 2012). This study is an addition to the sparse pool of case studies and provides empirical data from in-depth interviews with managers and stakeholders in the supply chain of a company in the pulp and paper industry and a description of its S&OP process.

6.3 Limitations

As is the case with most case studies, the generalizability of this study is weak in a statistical sense since there is no presence of a large sample that can be generalised to a population. However, while the statistical generalizability of the study results is on the weaker side, the validity must be considered high. There are three main arguments supporting this conclusion: Firstly, the use of high detail data from semi-structured interviews. Secondly, the use of data triangulation in order to lower the risk for data bias, in this case by asking the same questions to 19 interviewees. Finally, the risk for bias has been lowered further through the method of investigator triangulation, that is, by working in a research team of two investigators.

A limitation to the study is that there is no exact way of determining the final numeric score of the company’s S&OP maturity level. It can however be discussed how valuable it is to get this numeric answer to the maturity level of the company. While it could be useful to have a numeric value to establish a “best-of-breed” benchmark, it is not necessary to identify recommendations to the investigated company.

6.4 Future research

There are several areas in need of further research. Firstly, as stated in most research in the field of S&OP, there is still a great need for additional case studies of, and data collection from, companies in all industries. Secondly, there is a need for a more exact method of numerical determination of a company’s maturity level if “best-of-breed” benchmarks are to be established. It would also be useful with an investigation of the possibility to conduct maturity level
assessments with more quantitative methods such as numeric surveys. Further on, the maturity model generated in this research is developed especially for S&OP assessment in the process industry. It would be interesting to see more research on the possible need for adapted maturity models for other industries with specific industry characteristics as well. Finally, as S&OP is often treated like a generic process, while some industries, such as the process industry, have very specific characteristics, it would be interesting to explore the need of a more contextualised S&OP research.
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### Appendix I: Comparison of S&OP processes

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<tbody>
<tr>
<td>1</td>
<td>Data gathering</td>
<td>Unconstrained demand forecast</td>
<td>Consensus forecast</td>
<td>Collect sales and market input</td>
<td>Demand planning</td>
</tr>
<tr>
<td>2</td>
<td>Demand planning</td>
<td>Initial supply plan</td>
<td>Preliminary delivery plan</td>
<td>Develop a demand plan</td>
<td>Supply planning</td>
</tr>
<tr>
<td>3</td>
<td>Supply planning</td>
<td>Final operating plan</td>
<td>Preliminary production plan</td>
<td>Demand consensus refinement</td>
<td>Demand and supply plan review</td>
</tr>
<tr>
<td>4</td>
<td>Pre meeting - decisions and recommendations for executive meeting</td>
<td>Distribution and implementation of the plan</td>
<td>Adjusting delivery and production plan</td>
<td>Shape demand based on what-if analysis on demand for supply</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Executive meeting, establish game plan</td>
<td>Measurement of results and effectiveness</td>
<td>Settle delivery and production plan</td>
<td>Develop a constrained plan by supply</td>
<td>What-if analysis by supply to determine trade-offs and identify demand-shaping opportunities</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>Review and gain agreement through a consensus meeting</td>
<td>Publish the constrained plan</td>
</tr>
<tr>
<td>7</td>
<td></td>
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<td>Measure and communicate the plan</td>
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## Appendix II: Maturity model states, dimensions and elements

### Stage: 1

**Dimensions: 2**

**Elements: 3**

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</thead>
<tbody>
<tr>
<td>- Silo Culture</td>
<td>- Discussed at top level management meetings</td>
<td>- Staff Pre-Meetings</td>
<td>- Supplier &amp; customer data incorporated</td>
<td>- Event driven meetings supersede scheduled meetings</td>
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<tr>
<td>- No meetings</td>
<td>- Focus on financial goals</td>
<td>- Executive S&amp;OP Meetings</td>
<td>- Suppliers &amp; customers participate in parts of meetings</td>
<td>- Real-time access to external data</td>
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<tr>
<td>- No collaboration</td>
<td></td>
<td>- Some supplier/customer data</td>
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<table>
<thead>
<tr>
<th>Organization</th>
<th>Stage 1: No S&amp;OP organization</th>
<th>Stage 2: Reactive</th>
<th>Stage 3: Standard</th>
<th>Stage 4: Advanced</th>
<th>Stage 5: Proactive</th>
</tr>
</thead>
<tbody>
<tr>
<td>- No formal S&amp;OP function</td>
<td>- Two formal S&amp;OP function</td>
<td>- S&amp;OP function is part of other position: Product Manager, Supply Chain Manager</td>
<td>- Formal S&amp;OP team</td>
<td>- Throughout the organization, S&amp;OP is understood as a tool for optimizing company profit.</td>
<td></td>
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<tr>
<td>- Components of S&amp;OP are in other positions</td>
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<td>- Executive participation</td>
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</table>

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Stage 1: No measurements</th>
<th>Stage 2: Reactive</th>
<th>Stage 3: Standard</th>
<th>Stage 4: Advanced</th>
<th>Stage 5: Proactive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Measure how well Operations meets the sales plan</td>
<td>- Stage 2 plus: Sales measured on forecast accuracy</td>
<td>- Stage 3 plus: New Product Introduction</td>
<td>- Stage 4 plus: Company profitability</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- S&amp;OP effectiveness</td>
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<thead>
<tr>
<th>Information Technology</th>
<th>Stage 1: Individual managers keep own spreadsheets</th>
<th>Stage 2: Reactive</th>
<th>Stage 3: Standard</th>
<th>Stage 4: Advanced</th>
<th>Stage 5: Proactive</th>
</tr>
</thead>
<tbody>
<tr>
<td>- No consolidation of information</td>
<td>- Many spreadsheets</td>
<td>- Revenue or operations planning software</td>
<td>- Batch process</td>
<td>- Integrated S&amp;OP optimization software</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Some consolidation, but done manually</td>
<td></td>
<td>- Revenue &amp; operations optimization software – link to ERP but not jointly optimized</td>
<td>- Full interface with ERP, accounting, forecasting</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- S&amp;OP workbench</td>
<td>- Real-time solver</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S&amp;OP Plan Integration</th>
<th>Stage 1: No formal planning</th>
<th>Stage 2: Reactive</th>
<th>Stage 3: Standard</th>
<th>Stage 4: Advanced</th>
<th>Stage 5: Proactive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Operations attempts to meet incoming orders</td>
<td>- Sales plan drives Operations</td>
<td>- Plans highly integrated</td>
<td>- Seamless integration of plans</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Top-down process</td>
<td>- Concurrent &amp; collaborative process</td>
<td>- Process focuses on profit optimization for whole company</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Capacity utilization dynamics ignored</td>
<td>- Some plan integration</td>
<td>- Bottom up plans - tempered by business goals</td>
<td></td>
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</tr>
</tbody>
</table>

Centralized information

3
Appendix III: Interview protocol

Initial statements
- Presentation of researcher and purpose of the study
- Offer right to be anonymous
- Ask permission to record the interview
- Offer a transcript of the interview/final report

Background questions
- How long have you been with the case company? In what position(s)?
- What is your current title and what are your main responsibilities?
- What are your department’s main functions and responsibilities?

S&OP process questions
(1) Please describe your process to forecast demand:
- Bottoms up/top down/mixture?
  - Who is involved? What organizational levels?
  - Time frame: 3/6/12/18 month/other?
  - How long does it take to generate a forecast?
  - How often are forecasts generated and updated?
  - What tools do you use – spreadsheets/more sophisticated software?
  - Do you involve your customers?

(2) Please describe your process for supply or operations planning:
- Who is involved – organization?
- Are any of your suppliers involved?
- What inputs do you use from demand forecasts?
- Who sees the operations plans when complete – sales/marketing?

(3) Please describe how you integrate the demand and supply plans:
- Do you have meetings with both supply and demand side personnel?
- If so, how often?
- Is there pre-work for each meeting?
- Is there a formal process? Please describe.
- What time frame does S&OP focus on?
  - 0-3 months – 3-6 months – 6-18 months – Combination of the above?

(4) What IT structure is used for demand, supply, and S&OP planning?
• Spreadsheets – is there a single one or several? How many?
• Is there specific software suite that you use (e.g. Manugistics)?
• Are the demand and supply side systems linked?
• ERP system? – SAP, etc.
• I-supply web site?
• Scenario simulation and analysis?

(5) What measurements do you use to evaluate S&OP effectiveness?
• Financial: cash flow, revenue, costs
• Managerial accounting: residual cash flow, IRR
• Operational: inventory turns, obsolescence, delivery performance, capacity utilisation
• Marketing: accuracy of forecasts, variance to baseline
• New product introduction frequency & time to market, product churn
• How often are measurements taken?

(6) How do you respond to disruptions to your demand forecast?

(7) How do you respond to disruptions to operations?

(8) Meetings:
• Collaboration tools – video conference, physical presence, web tools?
• Customers? Suppliers?

(9) Organization:
• SOP coordinator? Full or part time? Who does he/she report to?
• SOP team – how many, full or part time, departments represented?
• Who from senior management is involved and how?

Follow up questions
(10) Is there anything else that you think we ought to be aware of regarding how the S&OP process is working and your interactions with the other functional areas in the process?

(11) Is there anyone else you would recommend we contact in order to get a better understanding of the objectives and inner workings of the S&OP process?

(12) Could we contact you in the future for clarification questions in case we uncover some gaps or inconsistencies as we go through our notes?
Appendix IV: Overview of restructured qualitative data
Stage 1 (1,5): No meetings - No formal S&OP meetings. No regular cross-functional meetings except for during planned stops, then mainly with production planners. However, Meetings once a month to discuss how well the production/sales meet the sales plan. Not clear who participate in these but does not seem to be including operations.

Stage 2: Many spreadsheets - Most planning and forecasting done in Excel (Overall organisation)

Stage 3: Some supplier/customer data - Collect input from the larger customers to prepare the sales forecast. Sometimes by phone and sometimes through physical meetings. E.g. large customers do without these volumes during the planned stop so that they don’t need to build inventory. Not stage 3: Some supplier/customer data - No supplier involvement

Stage 4: Suppliers and customers participate in parts of meetings - SEGMENT 3: Meetings that partly addresses (S&OP) planning with largest customers
Overall | Business area 3 | Overall | Overall
---|---|---|---
Stage 1: No meetings - No formal S&OP meetings (business area 1 and 3) | Stage 1: No meetings - No formal S&OP meetings. | Stage 1: No meetings - No formal S&OP meetings. Weekly planning meetings with close production sites. Monthly meetings on a grander perspective. | Stage 1: No meetings - Finance does not participate in any cross functional planning meetings. Describes finance as receiving plans from SCM and “getting to work” rather than having S&OP planning meetings.
Stage 1 (1,5): - Silo culture - No link between sales and production, except making sure the total volumes match (business area 1 and 3). (Some operational meetings for cross-functional teams with representatives from the business area, sales director, production and logistics. Not planning or forecasting meetings, more for problem handling and product development or new product introductions.) | Stage 1 (1,5): - No collaboration - Receive sales plan and production budget and starts the integration process from that, but without any further direct collaboration between sales and production. Collaboration through allocation manager. | Stage 1 (1,5): - No collaboration - There is collaboration but strictly on operational level. | Stage 1 (1,5): - No collaboration - Describes an organisation where finance and controller functions are quite insulated from sales and especially production. Does of course receive a lot of information connected to the budget process, but does not have any regular meeting or collaboration outside of that.
Stage 1 (1,5): - No collaboration - Cross-sectional S&OP meetings between production and sales (business area 1 and 3). (Some operational meetings for cross-functional teams with representatives from the business area, sales director, production and logistics. Not planning or forecasting meetings, more for problem handling and product development or new product introductions.) | Stage 2: Focus on financial goals - Planning based on the annual financial budget | Stage 3: Some supplier/customer data - Some supplier interaction, mostly keeping track to receive orders OTIF, does not incorporate information or prognosis from suppliers | Stage 2: Focus on financial goals - There is a management meeting connected to the review of plans connected to the budget deadlines with (absolute) focus on financial goals.
Stage 2: - Silo culture - No link between sales and production, except making sure the total volumes match (business area 1 and 3). (Some operational meetings for cross-functional teams with representatives from the business area, sales director, production and logistics. Not planning or forecasting meetings, more for problem handling and product development or new product introductions.) | Stage 2: Measures how well operations meet sales plan - Daily monitoring of how well operations meet production budget and sales meet sales budget. | Stage 3: Measures how well operations meet sales plan - Daily monitoring of how well operations meet production budget and sales meet sales budget. | Stage 3: Sales measured on forecast accuracy - There is no “hit-rate” on prognoses. In other words: No forecast accuracy is measured.
Stage 2: Measures how well operations meet sales plan - Measures how well the production budget is met. (Use of KPI such as OTIF, measured monthly.) | Stage 2: Measures how well operations meet sales plan - Daily monitoring of how well operations meet production budget and sales meet sales budget. | Stage 2: Measures how well operations meet sales plan - Daily monitoring of how well operations meet production budget and sales meet sales budget. | Stage 2: Measures how well operations meet sales plan - Daily monitoring of how well operations meet production budget and sales meet sales budget.
Stage 2 (1,5): - Measures how well operations meet sales plan - Measures how well the production budget is met. (Use of KPI such as OTIF, measured monthly.) | Stage 2: Many spreadsheets - All planning done in excel. | Stage 2: Many spreadsheets - Receive and develop prognoses exclusively in excel (developing a new software "lever"?) | Stage 2: Many spreadsheets - Describes a process where much of the planning input comes in spreadsheet form and the rest is retrieved from the order handling systems.
Stage 3: Receive or operations planning software system order bookings. (ERP system currently being implemented.) | Stage 2: Many spreadsheets - All planning done in excel. | Stage 2: Many spreadsheets - Receive and develop prognoses exclusively in excel (developing a new software "lever"?) | Stage 2: Many spreadsheets - Describes a process where much of the planning input comes in spreadsheet form and the rest is retrieved from the order handling systems.
Stage 2: - Capacity utilization dynamics ignored - Sales based on production capacity. | Stage 3: Some plan integration - Sales plan is not unreasonable considering production capability, but not optimised to it either. | Stage 2: Sales plan drives operations - Wood supply based on prognosis from production sites | Stage 2: Revenue or operations planning software - Uses information from order handling systems in financial controller system.
Stage 3: Some plan integration - Attempts to match sales forecast and production plan, iterative process. Done in the annual budget process and followed up quarterly. | Stage 3: Some plan integration - Production prognosis is many times adjusted down to better align with that of the client. | Stage 2: Top-down process - All some production sites where production is very stable, the planning seems entirely budget based. | Stage 3: Some plan integration - Describes a process where some S&OP integration is done by the Supply Chain Management team, but without any input from finance.
Stage 3: Some plan integration - Attempts to match sales forecast and production plan, iterative process. Done in the annual budget process and followed up quarterly. | Stage 4 (3,5): - Constraints applied to both directions - Production capacity drives allocation which constraints sales. So at least some constraints from production on sales planning. | Stage 3: Some plan integration - Production prognosis is many times adjusted down to better align with that of the client. | Stage 3: Sequential process in one direction only - Describes supply prognosis based on demand prognosis, but with some integration done by the SCM team.
Stage 3: Some plan integration - Attempts to match sales forecast and production plan, iterative process. Done in the annual budget process and followed up quarterly. | Stage 3: Some plan integration - Production prognosis is many times adjusted down to better align with that of the client. | Stage 3: Some plan integration - Production prognosis is many times adjusted down to better align with that of the client. | Stage 3: Sequential process in one direction only - Describes supply prognosis based on demand prognosis, but with some integration done by the SCM team.
### Business area 2

<table>
<thead>
<tr>
<th>Stage 1: No meetings - No formal S&amp;OP meetings</th>
<th>Stage 1: No meetings - No direct meetings between production and sales</th>
<th>Stage 1: No collaboration - No direct contact between sales and operations. Only one real crossfunctional contact who in turn have contact with production planners.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1 - No collaboration - No meeting between sales and production, communication through S&amp;OP manager. No formal meeting between S&amp;OP manager and sales either, only triggered meetings. No direct contact between production and sales.</td>
<td>Stage 1: No collaboration - No direct contact between production and sales. Communication through S&amp;OP manager and account managers.</td>
<td>Stage 1 (1.5): No collaboration - No direct contact between sales and operations, contact through Sales coordination manager.</td>
</tr>
<tr>
<td>Stage 2: Focus on financial goals</td>
<td>Stage 2: No collaboration - No meeting between sales and production, communication through S&amp;OP manager and account manager. S&amp;OP manager meets with production monthly. Account manager and S&amp;OP manager have ongoing communication.</td>
<td>Stage 1: No measurements - Sales volumes are measured monitored compared with budget every month. Customer service measures OTIF monthly, changes in inventory levels are also monitored.</td>
</tr>
<tr>
<td>Stage 3: Some Supplier/Customer data - Uses customer and retailer input in the forecasting process. Monthly or quarterly meetings with key customers.</td>
<td>Stage 3: Staff Pre-Meetings - Account managers have pre-meetings, before meeting S&amp;OP.</td>
<td>Stage 2: Some consolidation but done manually (First by sales director and then [probably?] sent to S&amp;OP manager)</td>
</tr>
<tr>
<td>Stage 3: Some Supplier/Customer data - Uses customer and retailer input in the forecasting process. Monthly or quarterly meetings with key customers.</td>
<td>Stage 4: Supplier/Customer data incorporated - Uses customer data in forecasts and planning. Cluster meetings with major customer monthly.</td>
<td></td>
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### Business area 3

<table>
<thead>
<tr>
<th>Stage 2 (1.5): Measures how well operations meets the sales plan - No formal process to follow and measure the forecast accuracy. Progress/performance reviewed more or less weekly, both against official budget and when there is deviation against forecast.</th>
<th>Stage 2 (1.5): Measures how well operations meets the sales plan - Forecast accuracy not measured per se. Sales volumes are measured and monitored regularly and compared with budget. Similarly production is measured and compared with budget continuously (production budget partly based on sales plan). OTIF also measured.</th>
<th>Stage 1: No measurements - Sales volumes are measured and monitored compared with budget every month which in turn can have an effect on the allocations for coming periods, but no other measurements.</th>
</tr>
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<tbody>
<tr>
<td>Stage 3: Centralised information - Forecasts fed into a forecasting tool with prices and volume. (Forecasts from previous years also available in the software.)</td>
<td>Stage 3: Revenue or operations planning software Sement 3 uses information portal. In the information portal a major customer enters their forecasts monthly for at least 3 months forward. Software, “SMI” (supplier managed inventory), with information on production cycles and safety inventory levels. Order booking and quota handling.</td>
<td>Stage 2: Some consolidation but done manually (First by sales director and then [probably?] sent to S&amp;OP manager)</td>
</tr>
<tr>
<td>Stage 3: Bottom up plans tempered by business goals - Sales forecast bottom-up from sales/customers during the budget process. Taking some constraints into account when compiled. New forecasts generated a number of times per year based on budget. Forecast delivered to production.</td>
<td>Stage 3: Bottom up plans tempered by business goals - Sales forecast bottom-up from sales/customers. Yearly forecast from major customer for each factory and material. In addition forecast from major customer are received monthly on product code level for at least 3 months forward, however not used to control production blocks today.</td>
<td>Stage 3: Bottom up plans tempered by business goals - Production plan is mainly based on the sales plans/sales prognosis created by sales managers and production. Tempered by business goals, e.g. if one product segment is more profitable than volumes of another less profitable segment might be reduced in response. This tempering is not done by sales however.</td>
</tr>
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</table>
Stage 1: No meetings - No meetings connected to planning or forecasting.

Stage 1: No collaboration - Does not collaborate with any other departments when forming the prognosis on individual level. Certainly not with operations. Only communication outside of sales is with supply chain when there are allocation/customer classification issues.

Stage 1: Silo culture - Sales are siloed from rest of organisation in many regards. Does get some input from market sometimes.

Stage 1: No measurements - Sales measured on volume and monitored compared with budget (sales plan), but not on their own forecast accuracy.

Stage 1: Individual managers keep own spreadsheets - One manager creates/keeps his own spreadsheet to avoid overbooking.

Stage 1: Manager, Sales

Stage 1: Manager, Production planning

Stage 1: Manager, Production planning

Stage 1: Manager, Production planning

Stage 1: No collaboration - No interaction outside of the production site, but does have weekly meetings with production and lead planner. Any contact with other parts of the organisation, such as sales and in extension customers, seems to go through the lead planner.

Stage 1 (1,5): No meetings - Does attend some meetings (physical and telephone) with market and sales for information regarding the current market situation.

Stage 1 (1,5): No collaboration - There are however some collaboration with markets who contact production planning in the case of required rescheduling because of large clients demands.

Stage 2 (1,5): Measures how well operations meet sales plan - Some measurements: Volumes are measured and monitored compared with budget every day, week, month and quarter. Have also started to measure planned production loss compared to actual production loss when conducting planned stops.

Stage 2: Many spreadsheets - Describes the use of different spreadsheets for e.g. planned production stops, production pace, buffer development etc.

Stage 2: Revenue or operations planning software: Order handling in is connected to production planning in, used for planning and trimming material production, can be seen as sort of MRP system.

Stage 3: Some plan integration - Sales adapt plans such as which customers will receive what and what product mix to sell during planned stops in production.

Stage 3: Centralized information - Information in order handling system can be reach by everyone but not in any automated way.
<table>
<thead>
<tr>
<th>Business area 1</th>
<th>Business area 1</th>
<th>Business area 3</th>
<th>Business area 2</th>
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<tbody>
<tr>
<td><strong>Stage 1: No meetings</strong>&lt;br&gt;There are no formal planning meetings between sales and production. Load planner meets with production, and allocation manager has weekly meeting with team leaders of the sales offices.</td>
<td><strong>Stage 1 (1,5): No collaboration</strong> (Some collaboration)&lt;br&gt;One sales representative attends morning meetings. This is in an informative capacity, not for planning/forecasting reasons. Also, markets attend local production meetings a few times a week. And representatives from the business area come to inform the production site a few times a year.</td>
<td><strong>Stage 1 (1,5): No meetings</strong>&lt;br&gt;There are no formal S&amp;OP meetings. Cross-functional meetings during budget-process.</td>
<td><strong>Stage 3: Some supplier/customer data</strong>&lt;br&gt;Segment 3 has a well developed information exchange with largest customers. Not so much within segment 4.</td>
</tr>
<tr>
<td><strong>Stage 3: Some supplier / customer data - Some customer input during development of sales forecast</strong></td>
<td><strong>Stage 1: No meetings</strong>&lt;br&gt;There are no formal S&amp;OP meetings</td>
<td><strong>Stage 2: Discussed at top level management meetings</strong>&lt;br&gt;Describes a monthly top level management meeting between senior vice presidents of business areas and SCM directors meet and discuss S&amp;OP and planning on a strategic level.</td>
<td><strong>Stage 3: Some supplier / customer data - Some customer input during development of sales forecast</strong></td>
</tr>
<tr>
<td><strong>Stage 2 (1,5): Measure how well Operations meets the sales plan</strong>&lt;br&gt;Continuously Measure how well production meets the production plan in volume produced. (Production plan = production budget)&lt;br&gt;Also measures how much is booked in different segments and time periods. In addition a number of KPI's are used e.g. OTIF.</td>
<td><strong>Stage 2 (1,5): Measure how well Operations meets the sales plan</strong>&lt;br&gt;Measure how well production meets the production plan in volume produced. (Production plan = production budget)&lt;br&gt;Also measures how much is booked in different segments and time periods. In addition a number of KPI's are used e.g. OTIF.</td>
<td><strong>Stage 2: Discussed at top level management meetings</strong>&lt;br&gt;Describes a monthly top level management meeting between senior vice presidents of business areas and SCM directors meet and discuss S&amp;OP and planning on a strategic level.</td>
<td><strong>Stage 3 (2,5): Revenue or operations planning software</strong>&lt;br&gt;Sales budget received in excel. Put into the order booking system, making it available for everyone. A planning system called and a production system called are also used. The order is booked, allocated and sent from for “trimming”.&lt;br&gt;Order handling system &amp; local production system (e.g. production planning) &amp; Production system for monitoring “ceiling values” in real time.</td>
</tr>
<tr>
<td><strong>Stage 3 (2,5): Revenue or operations planning software</strong>&lt;br&gt;Sales budget received in excel. Put into the order booking system, making it available for everyone. A planning system called and a production system called are also used. The order is booked, allocated and sent from for “trimming”.&lt;br&gt;Order handling system &amp; local production system (e.g. production planning) &amp; Production system for monitoring “ceiling values” in real time.</td>
<td><strong>Stage 1: Operations attempts to meet incoming orders</strong>&lt;br&gt;Describes production planners getting incoming orders and trying to structure the orders so that they are met in time</td>
<td><strong>Stage 3: Bottom up plans tempered by business goals</strong>&lt;br&gt;Plans based on contracts with customers and information and prognoses from market and sales (which in turn are based on customer prognoses as well)</td>
<td><strong>Stage 3: Bottom up plans tempered by business goals</strong>&lt;br&gt;Bottom-up from sales for the upcoming year.</td>
</tr>
<tr>
<td><strong>Stage 2: Sales plan drives operation</strong>&lt;br&gt;Operations receives a budget from sales about the demand on different markets and how much they are planning to sell every month (yearly budget). Production budget based on that. (Still somewhat two way as the production plan entails some restrictions to the different sales offices.)</td>
<td><strong>Stage 1: Operations attempts to meet incoming orders</strong>&lt;br&gt;Describes production planners getting incoming orders and trying to structure the orders so that they are met in time</td>
<td><strong>Stage 3: Bottom up plans tempered by business goals</strong>&lt;br&gt;Bottom-up from sales for the upcoming year.</td>
<td><strong>Stage 3: Bottom up plans tempered by business goals</strong>&lt;br&gt;Bottom-up from sales for the upcoming year.</td>
</tr>
<tr>
<td><strong>Stage 3: Bottom up plans tempered by business goals</strong>&lt;br&gt;Plans based on contracts with customers and information and prognoses from market and sales (which in turn are based on customer prognoses as well)</td>
<td><strong>Stage 3: Bottom up plans tempered by business goals</strong>&lt;br&gt;Bottom-up from sales for the upcoming year.</td>
<td><strong>Stage 3: Bottom up plans tempered by business goals</strong>&lt;br&gt;Bottom-up from sales for the upcoming year.</td>
<td><strong>Stage 3: Bottom up plans tempered by business goals</strong>&lt;br&gt;Bottom-up from sales for the upcoming year.</td>
</tr>
</tbody>
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## Appendix V: Overview of interviewees

<table>
<thead>
<tr>
<th>Interview No.</th>
<th>Subgroup</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interview 1 (I1)</td>
<td>Business area 1</td>
<td>Director, Sales</td>
</tr>
<tr>
<td>Interview 2 (I2)</td>
<td>Overall</td>
<td>Director, Supply chain management</td>
</tr>
<tr>
<td>Interview 3 (I3)</td>
<td>Overall</td>
<td>Manager, Supply chain management</td>
</tr>
<tr>
<td>Interview 4 (I4)</td>
<td>Overall</td>
<td>Director, Supply chain management</td>
</tr>
<tr>
<td>Interview 5 (I5)</td>
<td>Business area 3</td>
<td>Manager, Supply chain management</td>
</tr>
<tr>
<td>Interview 6 (I6)</td>
<td>Overall</td>
<td>Manager, Forestry</td>
</tr>
<tr>
<td>Interview 7 (I7)</td>
<td>Overall</td>
<td>Manager, Finance</td>
</tr>
<tr>
<td>Interview 8 (I8)</td>
<td>Business area 2</td>
<td>Director, Sales</td>
</tr>
<tr>
<td>Interview 9 (I9)</td>
<td>Business area 2</td>
<td>Manager, Sales</td>
</tr>
<tr>
<td>Interview 10 (I10)</td>
<td>Business area 3</td>
<td>Manager, Sales</td>
</tr>
<tr>
<td>Interview 11 (I11)</td>
<td>Business area 3</td>
<td>Manager, Sales</td>
</tr>
<tr>
<td>Interview 12 (I12)</td>
<td>Business area 1</td>
<td>Manager, Sales</td>
</tr>
<tr>
<td>Interview 13 (I13)</td>
<td>Business area 2 (Production unit 3)</td>
<td>Manager, Production planning</td>
</tr>
<tr>
<td>Interview 14 (I14)</td>
<td>Business area 3 (Production unit 3)</td>
<td>Manager, Production planning</td>
</tr>
<tr>
<td>Interview 15 (I15)</td>
<td>Business area 3 (Production unit 3)</td>
<td>Manager, Production</td>
</tr>
<tr>
<td>Interview 16 (I16)</td>
<td>Business area 1</td>
<td>Manager, Production planning</td>
</tr>
<tr>
<td>Interview 17 (I17)</td>
<td>Business area 1</td>
<td>Manager, Production</td>
</tr>
<tr>
<td>Interview 18 (I18)</td>
<td>Business area 3</td>
<td>Management team</td>
</tr>
<tr>
<td>Interview 19 (I19)</td>
<td>Business area 2</td>
<td>Management team</td>
</tr>
</tbody>
</table>
## Appendix VI: Identified elements from case company analysis

|--------------------------|----------------------------|------------------|------------------|------------------|------------------|
| Silo Culture             | • No meetings
• No collaboration | • Discusses at top level management meetings
• Focus on financial goals | • Staff Pre-Meetings
• Executive S&OP Meetings | • Supplier & customer data incorporated
• Suppliers & customers participate in parts of meetings | • Event driven meetings
• S&OP mix changes to meet external data |

<table>
<thead>
<tr>
<th>Organization</th>
<th>Stage 1: No S&amp;OP organization</th>
<th>Stage 2: Reactive</th>
<th>Stage 3: Standard</th>
<th>Stage 4: Advanced</th>
<th>Stage 5: Proactive</th>
</tr>
</thead>
</table>
| No S&OP function         | • 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 profitability |

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Stage 1: No measurements</th>
<th>Stage 2: Reactive</th>
<th>Stage 3: Standard</th>
<th>Stage 4: Advanced</th>
<th>Stage 5: Proactive</th>
</tr>
</thead>
</table>
| No measurements          | • Measure operations
• Sales measured on forecast accuracy | • Stage 2 plus
• New Product Introduction
• S&OP effectiveness | • Stage 4 plus
• Company profitability |

| Information Technology   | Stage 1: Individual managers keep own spreadsheets
• No consolidation of information | Stage 2: Many spreadsheets
• Some consolidation, but done manually | Stage 3: Revenue or operations planning software |
|--------------------------|-------------------------------|------------------|------------------|
|                        | • Batch process
• Revenue & operations optimization software—link to ERP but not fully optimized
• S&OP workbench | • Integrated S&OP optimization software
• Full interface with ERP, accounting, forecasting
• Real-time delivery |

| S&OP Plan Integration    | Stage 1: No formal planning
• Operations attempt to meet incoming orders | Stage 2: Sales plan drives Operations
• Top-down process
• Capacity utilization dynamics ignored | Stage 3: Some plan integration
• Sequential process |
|--------------------------|-------------------------------|------------------|------------------|
|                        | • Bottom-up plans - computed by business goals | • Plans highly integrated
• Concurrent & iterative | • Constraints applied in both directions |

<table>
<thead>
<tr>
<th>Integration</th>
<th>Stage 1: Seamless integration of plans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Process focuses on profit optimization for whole company</td>
</tr>
</tbody>
</table>
Appendix VII: Expected time consumption

Below follows a suggested way to calculate the expected time for conducting a maturity model analysis using the process suggested in section 5.4. All time constants are calculated from empirical measurements from this case study.

Approximation of required number of interviews:

\[ I = S \times Fs + Fo \]  \hspace{1cm} (1)

Where: \( I \) = Number of interviews required, \( S \) = Subunits, \( Fs \) = Subunit functions, \( Fo \) = Overall company functions

Expected time consumption for conducting interviews

\[ It = I \times L \]  \hspace{1cm} (2)

\( It \) = Interview time consumption, \( L \) = 30 (expected length of interviews in minutes), \( I \) = from (1)

Expected time consumption for transcribing interviews:

\[ T = Tc \times It \]  \hspace{1cm} (3)

Where: \( T \) = Expected time consumption of transcribing in minutes, \( 3 < Tc < 5.5 \) (transcribing constant depending on keyboard speed, sound and speech quality), \( It \) = from (2)

Expected time consumption for reducing and restructuring transcribed interviews:

\[ R = Rc \times T \]  \hspace{1cm} (4)

\( Rc = 0.8 \) (Reduction and restructuring constant), \( T \) = from (3)

Map data to maturity model:

\[ M = Mc \times I \]  \hspace{1cm} (5)

Where: \( M \) = Expected time consumption of mapping data to maturity model, \( Mc = 3.2 \) (mapping constant), \( I \) = from (1)

Compile data:

\[ \text{89} \]
\[ C = I \]  \quad (6)

C = \text{Expected time consumption for compiling data, } I = \text{ from (1)}

Final time consumption:

\[ F = It + T + R + M + C \]  \quad (7)

Where \( F \) = \text{Final time consumed for maturity model process, } It = \text{ from (2), } T = \text{ from (3), } R = \text{ from (4), } M = \text{ from (5), } C = \text{ from (6)}