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Purchasing & Supply Management

Designing a Sales and Operations Planning Process in a Make-to-Order Environment

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Abstract

Volatility in the supply chain results in misalignment between supply and demand, leading to the development of proper strategies to deal with mismatches between supply and demand. Sales and Operations Planning is a powerful process to align supply and demand by linking sales plans with supply and operations planning. However, since S&OP processes have been used in a standardized way, it is not completely clear how to design the S&OP process in order to address companies' different necessities, especially when adjusting the process to a make-to-order environment. This study investigates how to design a S&OP process in a MTO environment. Research was conducted as a case study in a Dutch company in the steel industry. Data was collected by interviewing 9 employees of this company. Academical literature and results from the interviews were combined to create a framework for designing S&OP in a make-to-order environment. This research showed that companies in a MTO environment cannot easily adopt a S&OP process, since the process needs to be reviewed first before implementation, so it will fit within company specific characteristics. Factors that should be reviewed in any case are the stakeholders of the process, execution of the process steps, time horizon of the process in general and measurement and analysis of the process as a whole and the process steps independently.

Keywords

Sales and Operations Planning, make-to-order, purchasing and supply management, forecasting, supply chain volatility, organisational alignment

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1. Introduction

Volatility in the supply chain is a “much discussed phenomenon” and “one that both managers and researchers rank among the most important phenomena” in supply chain management (Nitsche & Durach, 2018; Handfield et al., 2013; Wieland et al., 2016). Volatility is used to describe unplanned variation in material flows along the supply chain, resulting in misalignment between supply and demand (Nitsche & Durach, 2018; Childerhouse et al., 2008; Handfield et al., 2013; Lee, 1997; Nitsche & Straube 2020). Additionally, it appears that firms do not have proper strategies to deal with high volatile market situations. Especially for organisations in a make-to-order (MTO) environment that have a high mix of products, low volume setting with a complex supply chain it is critical to be able to manage risks and disruptions (Kahiluoto et al., 2020). Because MTO is a production strategy that allows customers to customize products to their specifications, these types of companies are more vulnerable to disruptions. They typically face challenges like irregular demand and customisation, lengthy delivery times and the need for inventory management (van Weele, 2018).

The role of Sales and Operations Planning (S&OP) is widely acknowledged to be a key business process for aligning supply and demand and is perceived as common practice in most manufacturing companies (Tuomikangas & Kaipia, 2014; Kreuter et al., 2021; Jonsson et al., 2021). S&OP is able to help with aligning supply and demand by linking sales plans with supply and operations planning, while simultaneously streamlining communications between internal, as well as, external departments and functions (Ávila et al., 2019; Enchange, 2021). However, maintaining this position is challenged by the need to connect planning with daily supply chain execution and align supply and demand while at the same time responding to volatility in the supply market (Jonsson et al., 2021). Additionally, Stentoft et al. (2020) came to the conclusion that the lack of knowledge about S&OP still significantly influences the perception of relevance of S&OP. Simultaneously, it is not completely clear how to design the S&OP process, especially regarding adjusting the process in a MTO environment, in order to implement a thorough process or improve the current process.

So, the utilisation of Sales & Operations Planning as a forecasting process is expected to provide organisations with tools, knowledge and skills. When executed correctly, this will lead to an improved management of lead times, inventories and risks, so eventually

companies will be able to align supply and demand and manage supply chain volatility. However, implementation is perceived as difficult and challenging, especially in complex environments where S&OP has received little attention (Pedroso et al., 2016). Besides, when it comes to challenges regarding implementing a S&OP process, Tuomikangas & Kaipia (2014) highlight the prediction of demand changes (volatility) and accordingly aligning supply of materials in a cost-efficient manner. Additionally, Jonsson et al. (2021) focus on complexity through an increasing dynamic and volatile planning environment. Which is strenthened for companies operating in a make-to-order environment. Moreover, Ivert et al. (2015) state that in current literature S&OP is designed and presented as a strict, formal and standardized process which is equal for all companies, meanwhile their research provides evidence of the need to adjust S&OP processes according to the organisation and its environment.

Therefore, the research goal is to identify how a Sales & Operations Planning (S&OP) process should be designed in order to address uncertainty in a make-to-order environment. Consequently, the following research question has been formulated: *How should a Sales & Operations Planning (S&OP) process be designed in order to address uncertainty in a make-to-order environment?*

Currently, the limited available literature on S&OP only discusses standardized processes. Therefore, because of the limited research and knowledge on Sales and Operations Planning processes customised for MTO environments including design (Sharma et al., 2020; Ivert et al., 2015), the execution of this research based on a case study on S&OP and its design in MTO environments is justified and contributes to academical literature on this topic.

The practical role of this research is to enable companies to balance production capacity (supply) and demand, through the implementation of a customised Sales and Operations Planning process, specifically designed for companies in a make-to-order environment. Simultaneously, this research offers practical relevance in the sense that it provides managers and practitioners in the field with knowledge, insights and support regarding the implementation of a stepwise process design of a thorough Sales & Operations Planning as a forecasting tool in a make-to-order environment. By doing so, it is expected that companies will be enabled to improve operations regarding the management of lead times, inventories and risks. As a consequence, S&OP facilitates

companies to align and integrate the supply chain between and within distinct functions across both suppliers and customers along the supply chain. Additionally, according to Ávila et al. (2019) through the implementation of a S&OP process, companies will be able to improve their forecast accuracy, improve the on time delivery, reduce supply chain costs and enable growth.

The first part of this research involves a literature review on Sales and Operations Planning and associated topics. The second part contains the established theoretical framework, based on the literature review, while the third part consists of the methodology regarding this research. The fourth part includes the results from data collection. These findings are discussed in the fifth part. Based on the results and discussion, the conclusion will be given in part six.

1.1 Company background

The initial idea regarding the research was developed by Voortman Steel Machinery and therefore, the company is used as a case in which the research will be conducted.

Voortman was founded in 1968 in Rijssen, The Netherlands, by the brothers Voortman. For the first two years, they had a broad focus on all kinds of machinery, but in 1970 the focus shifted towards mechanisation, which led to the company's rapid growth. After six years, the company's focus broadened, and Voortman started designing and building steel construction frames. Four years later, in 1980, the Voortman family split the company between Voortman Automatisering B.V., which is now known as Voortman Steel Machinery B.V. and Voortman Staalbouw B.V., currently known as Voortman Steel Construction B.V. (Voortman Steel Group, 2022).

Since 1995, Voortman Steel Machinery (VSM) designs, develops, and produces various CNC-controlled machines and production lines for the steel construction industry (Voortman Steel Group, 2022). VSM's customers are mainly steel construction companies that purchase these machines to automate their production process. Voortman Steel Group (VSG) currently has about 500 employees divided over the two divisions, VSM and Voortman Steel Construction (VSC). VSG's head office is still located in Rijssen and, in addition, also has (sales/service) locations in America, Australia, Germany, England, France, Poland and Russia (Voortman Steel Group, 2022).

The machines of VSM have a modular design, i.e. the machines are composed of modules and the modules are composed of parts. When it comes to the engineering of the machines, the use of a modular machine design enables VSM to configure machines to order with predesigned modules. On the other hand, from a production perspective, the machines are manufactured according to make-to-order principles. This combination leads to a wide variety, low volume but high value product portfolio. However, this means ordering and production processes tend to be reactive when it comes to the availability and reliability of materials needed for production of the CNC-controlled machines.

In regard to obtaining the needed materials, Voortman considers 5 different flows of goods. E.g. service parts, consumables and machine parts. On a yearly basis Voortman places a total of 20.000 to 25.000 orders, which accumulate towards a total purchasing volume of 105.000 parts with a total value of about €60 million.

The combination between the high amount of orders and purchasing volume and challenging internal demands concerning lead times and delivery moments, results in a complex purchasing and supply issue in which the alignment between supply and demand gets pressured, especially with the current high volatile market situation in the make-to-order environment.

1.2 Structure of thesis

In the next chapter, the literature review is conducted. This will be the basis for the theoretical framework and research methodology used during this project, which will be discussed in chapters 3 and 4. Chapter 5 will contain the results of the acquired data. Discussion of the findings will be explained in chapter 6, followed by chapter 7 consisting of the conclusion.

2. Literature Review

To start this research, a literature review has been conducted. The review follows the guidelines of a literature review as formulated by Templier & Paré (2015). This type of literature review can be regarded as reliable, valid and repeatable (Xiao & Watson, 2019). The theory section covers five main themes, namely make-to-order manufacturing strategy, supply chain volatility, organisational alignment, Sales and Operations Planning and Purchasing and Supply Management.

During this literature review, the data bases of Google Scholar and ScienceDirect have mostly been used, since these provide a wide range of articles, enable the researcher to search broadly, but also very specific on e.g. certain topics or papers from a certain journal. Next to this, these two data bases give insights into the different journals regarding the source of literature. To start the literature review, keyword search was conducted in ScienceDirect. For futher literature used in this research, the snowballing effect was used, which led to other useful papers.

2.1 Make-to-order (MTO) Manufacturing Strategy

Strong competition in the market and technological advancements mean that customer requirements regarding products are very high, with customers expecting a wide range of high quality products, frequent introduction of new models and attractive prices. The products are nowadays increasingly more complex, leading to the creation of a complex supply chain. Simultaneously, the need for flexibility to customize products to the requirements of the customer increased. As a result make-to-order as a manufacturing strategy has gained popularity (Saniuk & Waszkowski, 2016).

Hill (2000) defined make-to-order (MTO) as a term that refers to companies that “produce bespoke and customise products to particular customer specifications but not repeated on a regular basis or in a predictable manner”. Production starts after the order has been received. In other words, “all supply chain tasks ranging from procurement of materials, parts and components, to fabrication, subassembly and assembly, until final delivery are triggered by receipt of a customer order” (Li & Womer, 2012). Voortman Steel Machinery as a case company is a perfect example of an organisation that is situated in a make-to-order environment. This leads to the production of high variety, low volume products. Companies that use MTO as a production strategy usually have few standard

products and a volatile demand which is difficult to predict. In addition, a lack of coordination between Sales and production regarding customer requests often leads to orders being delivered later than promised and/or being produced at a loss (Kingsman et al., 1996).

The main advantage of MTO as a production strategy is the ability to produce an order to the precise specification given by the customer, while reducing inventories of finished products and limiting exposure to the risk of obsolence (Saniuk & Waszkowski, 2016; Vidyarthi et al., 2009; Gupta & Benjaafar, 2004). On the other hand, lead times increase since orders are produced once they are received and costs increase due to the customisations demanded by the customer. Additionally, capacity planning, order acceptance and rejection and attaining high due date fulfilment are perceived as operational challenges for companies in a make-to-order environment (Stevenson et al., 2005; Soman et al., 2004).

MTO can be found in many industries and often closely relates to just-in-time (JIT). It primarily differs from other strategies, such as assemble-to-order (ATO) and make-to-stock (MTS) when it comes to the order decoupling point (Wouters, 1991). The decoupling point is usually described as the point in the supply chain where the product is linked to a specific customer order. This is also the point were product specifications get frozen in most cases (Olhager, 2010; Sharman, 1984; Olhager, 2003).

MTS has the decoupling point towards the customer, ATO generally includes the manufacturing stage of products in the decoupling point, while MTO also involves procurement, as well as manufacturing (Gunasekaran & Ngai, 2005; Bertrand & Sridharan, 2001; Kolisch, 2001).

2.2 Supply Chain Volatility

As discussed in the introduction, volatility is regarded as “much discussed and highly ranked by both managers and researchers” (Nitsche & Durach, 2018; Handfield et al., 2013; Wieland et al., 2016). Additionally, Nitsche & Straube (2020) named volatility “one of the core challenges” in supply chain management. Volatility is used to describe unplanned variation in material flows along the supply chain, resulting in misalignment between supply and demand (Nitsche & Durach, 2018; Childerhouse et al., 2008; Handfield et al., 2013; Lee, 1997; Nitsche & Straube 2020). This is strengthened by the

fact that competition between businesses is increasingly being contested at the supply chain level of analysis. Rather than competing firm versus firm, today's organisations are battling supply chain versus supply chain (Ketchen & Hult, 2007). This misalignment causes a disrupted flow of products and uncertain and significantly increased lead times regarding purchasing and supply of materials (Joglekar & Phadnis, 2020; Kahiluoto et al., 2020; Jonsson et al., 2021). Consequently, these longer lead times will increase task complexity regarding inventory management and negatively affect supply chain responsiveness and customer satisfaction (Chang & Lin, 2019). Simultaneously, total costs of supply will increase significantly in combination with the need for improved speed, quality and service driven by evolving customer demands (Deloitte Insights, 2021). Besides, additional pressure is created by the growing need for risk management strategies, because of trends regarding globalisation, technological progress, corporate social responsibility and the increasing dependency on suppliers and other stakeholders (Jonsson et al., 2021; Kahiluoto et al., 2020)

In order to create a sustainable supply of materials companies need to establish a strategy, including the right processes and tools, in which the alignment between supply and demand is the core focus, but also contains risk management in order to assure the availability of materials in high volatile market situations (Glas et al., 2021; Patrucco & Kähkönen, 2021; Sharma et al., 2020). This is essential, since most supply chains will face disruptions some time, mainly caused by demand drops and surges (volatility) and supply shortages (Accenture, 2022). Especially for companies that use make-to-order as a production strategy, aligning supply and demand is critical but also more challenging, because MTO's characteristics regarding the customisation of products makes companies more vulnerable to disruptions. Aligning supply and demand in a MTO context will lead to minimized delays and optimized delivery schedules, while companies ensure customer satisfaction by producing high quality products, and being sufficiently flexible regarding demand uncertainties (Stavrulaki & Davis, 2010). Therefore, in order to deal with supply chain volatility, it has become necessary to align supply and demand and create a sustainable supply of materials. According to Kahiluoto et al. (2020), Turner (2018) and Sharma et al. (2020), this can be achieved by rethinking the forecasting process and supply chain planning.

According to Nitsche & Durach (2018) volatility contains 5 dimensions: organisational volatility, vertical volatility, behavioural volatility, market-related volatility

and institutional and environmental volatility. An overview of these dimensions including the most important factors contributing to these dimensions can be seen in the table below and will be further discussed below the table.

Table 1: Dimensions Volatility

Dimensions volatility	Factors
Organisational Volatility	Unstable production process, inaccurate forecasting, intra-organisational misalignment, price variations
Vertical Volatility	Long and variable lead times
Behavioural Volatility	Erratic customer behaviour and erratic behaviour of decision makers in the supply chain
Market-related Volatility	Competition, seasonality and product life cycles
Institutional/environmental Volatility	Political/legal instability and economic/financial instability

Organisational volatility is induced by the company itself. Some factors influencing organisational volatility are “unstable production process, inaccurate forecasting, intra-organisational misalingment and price variations” (Nitsche & Durach, 2018). The same study stated that organisations are not able to control volatility in their supply chain when internal departments are not well integrated in the firm. Additionally, transmitting inaccurate forecasts to the supply side becomes challenging for the supplier, reinforcing misalignment between supply and demand (Adenso-Díaz et al., 2012; Barlas & Gunduz, 2011; Childerhouse et al., 2008; Lee et al., 1997; Nitsche & Durach, 2018).

Vertical volatility originates from partners along the supply chain (Nitsche & Straube, 2020). Most important factors affecting vertical volatility are long and variable lead times. According to Chaharsooghi & Heydari (2010), long and variable lead times influence stability of material flow dramatically. However, design of a supply chain including the design of flow of information also highly impact lead times (Childerhouse et al., 2003; Nitsche & Durach, 2018).

“The behaviour of individuals in the supply chain plays a vital role for the volatility of material flows” (Nitsche & Durach, 2018). This includes 2 factors, namely erratic customer behaviour and erratic behaviour of decision makers in the supply chain. Erratic customer behaviour relates to unpredictable customer demand. The higher the

unpredictability of customer demand, the more likely it is for supply and demand to become misaligned (Childerhouse et al., 2008). Decision makers' erratic behaviour contains irrational decisions at the firm or partners in the supply chain. This affects volatility, characterized by misjudgement of demand or supply signals (Ancarani et al., 2013; Nitsche & Durach, 2018).

Market volatility relates to volatility "induced by the market in which an organisation is located" (Nitsche & Straube, 2020) and is influenced by the competition, seasonality and product life cycles (Nitsche & Durach, 2018). Product characteristics like innovativeness, seasonality and the life cycle directly influence volatile customer demand (Childerhouse et al., 2008), while simultaneously being strenghtened by a high level of competition (Taylor & Fearne, 2009; Nitsche & Durach, 2018).

Institutional and environmental volatility originates external to the supply chain and is affected by "political and legal instability or economic and financial instability as well as exceptional environmental events" (Christopher & Holweg, 2017; Dooley et al., 2009; Thorbecke, 2008; Nitsche & Durach, 2018). An increasing significance of "exceptional events and crises" is assumed (Christopher & Holweg, 2017). This combined with the growing globalisation and political and legal instabilities lead to instabilities in the supply chain and influence flow of materials (Nitsche & Durach, 2018).

This research will mainly focus on vertical and market volatility. Vertical volatility influences the S&OP process through its factor regarding the length and variability of lead times. Market volatility affects the company and the S&OP process through the influence of competition and life cycles on demand volatility.

2.3 Organisational Alignment

According to Patrucco & Kähkönen (2021) and Lee (2004), alignment can be defined as the "organisational ability to align objectives and processes within and between different fucntions and members in the supply chain". This allows companies to integrate and coordinate supply chain processes. Alignment is considered as one of the key features that supply chains should possess when operating in a business environment. The impact of alignment capabilities has been primarily analysed in the supply chain domain concerning how it contributes to the definition of the supply chain strategy and the design of a supply chain network (Patrucco & Kähkönen, 2021). Traditionally, alignment was

focused on how to strengthen the relationship between buyer and seller (Lee, 2021). However, supply chains have become more interdependent, while simultaneously increasing concern on social and environmental implications. Not only is alignment nowadays concerned with more than just cost and revenue, but also the types and amount of stakeholders changed. Currently, stakeholders may include local covernments and NGOs, in contradiction to just buyer and seller.

Business processes such as purchasing, manufacturing, marketing and logistics must be aligned both internally as well as externally with supply chain partners in order to attain the goal of competitive advantage (Matthyssens & Vandenbempt, 2008; Whitten et al., 2012). This can be created by a) exchanging information and knwoledge with vendors and customers, b) clearly defining roles, tasks and responsibilities for suppliers and customers and c) sharing risks, costs and gains of improvement projects (Lee, 2004; Whitten et al., 2012).

Especially, the exchange of information is perceived as a positive factor when it comes to supply chain performance. As Ye & Wang (2013) investigated the effects of information sharing on operational performance in the context of supply chains. The paper concluded that information sharing has a direct and positive effect on cost efficiency and customer responsiveness, although sharing information is more likely to be useful when it comes to cost efficiency. Therefore, information sharing as a factor of alignment can be seen as a factor with a positive effect on operational performance (Ye & Wang, 2013; Wu et al., 2006; Li et al., 2009).

2.4 Sales & Operations Planning

Sales and Operations Planning can be defined as a key business process to develop a cross-functional tactical plan that integrates all business plans (Sales, Marketing, Development, Manufacturing, Sourcing and Finance) into one plan in order to achieve competitive advantage and provide management with the ability to strategically direct the business. The goal is to horizontally align supply and demand, while simultaneously vertically aligning business strategy and operational planning and execution (Ávila et al., 2019; Tuomikangas & Kaipia, 2014; Pereira et al., 2020; Jonsson et al., 2021). Additionally it is often described as a support for organisations to maximize opportunity, minimize risks, while providing firms with the ability to make trade-offs based on

profitability. Also, when implemented thoroughly, it is able to offer superior operational performance (Ávila et al., 2019). A S&OP can also be called an aggregate plan and is concerned with the quantity and timing of production for the intermediate future, in other words, 3 to 18 months ahead (Heizer et al., 2016; Pereira et al., 2020).

Combining the definition stated above with Shedlawski (2017), it can be concluded that the departments of sales, marketing, development, manufacturing, sourcing and finance can, typically, be seen as main stakeholders within the Sales and Operations Planning process. However, according to Tuomikangas & Kaipia (2014) and Grimson & Pyke (2007) the IT department, in a supporting role, must not be forgotten when it comes to the implementation of the S&OP process. Since the involvement of technology in the process is perceived as a requirement for the establishment of an adequate process. Therefore, the stakeholders can be segmented as can be seen in the table below. Sales and Marketing are responsible for the sales part of the process, while development, manufacturing and sourcing are responsible for the operational planning part of S&OP. Finance and IT play a supportive role in the process, since these departments don't provide data as input to the process and are involved in a later phase of the process (Ávila et al., 2019; Cecere et al., 2009; Grimson & Pyke, 2007).

Table 2: Stakeholders S&OP

Stakeholders S&OP	
Sales	Sales
	Marketing
Operational Planning	Development
	Manufacturing
	Sourcing
Supportive	Finance
	IT

There are multiple factors that need to be addressed in order to achieve a successful S&OP. These can be categorised as external and internal factors. The planning environment for S&OP has been affected by an increasing number of external factors including globalisation, global or local crises with a global impact, technological improvements and, most important, supply and demand volatility (Jonsson et al., 2021).

Various internal factors have implications on the performance of S&OP. These consist of objectives, i.e. cost reduction, the translation from planning to operational execution, but also the lack of alignment and communication within organisations (Wilson & Raman, 2017; Cecere, 2015; Jonsson et al., 2021). Other issues that need to be specifically addressed when implementing S&OP, are forecast accuracy, inventory management, on time delivery and risk management (Ávila et al., 2019; Enchange, 2021; Heizer et al., 2016).

In general, S&OP is divided in two destinct parts; production planning and sales planning. “The collaboration between these two functions can be considered as an important performance indicator for further improvements in organisation’s total performance. The aim is to mix the sales and operation plans to establish balance between production capacity (supply) and demand” (Nemati et al., 2017). According to Thomé et al., (2012) S&OP provides organisations with operational improvements, e.g. regarding managing inventories and risks. Futhermore, S&OP facilitates supply chain alignment and integration between and within different functions with both suppliers and customers. This gives companies the opportunity to achieve a sustainable supply of materials.

A Sales and Operations Planning process provides firms with benefits. At first, it helps companies to improve the accuracy of their forecast by 20% to 50% and reduce stock levels by 10% to 30%. In addition, it improves the on time delivery by approximately 5% to 10% and reduces supply chain costs (Hinkel et al., 2016). Second, it is expected to be a key enabler of growth, has a positive effect on sales and increases revenues by 2% to 8% (Hirneisen, 2017). Finally, a S&OP process streamlines communication and improves the flow of information within a company (Ávila et al., 2019; Enchange, 2021; Heizer et al., 2016).

In order to benefit from the advantages S&OP is able to provide firms regarding maximising opportunity, minimizing risks and making conscious trade-offs based on profitability (Cecere et al., 2009), it is necessary to implement the plan step by step. This will lead to superior operational performance (Lapide, 2004). The steps can be divided into five main characteristics, consisting of the following (Thomé et al., 2012; Ávila et al., 2019):

- It is a cross-functional and integrate tactical planning process
- It integrates the multiple business plans into a single plan

- It contains a planning horizon of approximately 18 months
- It links strategy and operations
- S&OP creates value and is related with the performance of the firm

A standardized S&OP process consists of the following steps (Ávila et al., 2019):

1. Create unconstrained demand forecast

The first step of the process consists of gathering projected sales data that is used as an initial forecast, also called demand plan, typically performed by the sales and/or marketing departments. It should focus on customer demand, regardless of limitations due to production capacities. Furthermore, it includes information about new product introductions and products approaching the end of the product life cycle. The expected outcome is an unconstrained demand plan (forecast), which is the basis of the Sales and Operations Planning process (Grimson & Pyke, 2007; Lapide, 2004). The decision regarding the planning horizon is key in this step. When it comes to S&OP, 3 to 18 months is the most common horizon (Heizer et al., 2016; Pereira et al., 2020). However, this horizon may differ by industry, length of lead times and seasonality. Companies with long lead times tend to use a longer planning horizon, compared to companies with short lead times. Additionally, firms can choose to develop an annual S&OP plan, e.g. in line with the yearly budgeting cycle or use a rolling horizon and update the plans and forecast in the regular S&OP meetings (Grimson & Pyke, 2007).

2. Create the initial supply plan

In the second step of the process, operations and supply teams, consisting of development, manufacturing and sourcing departments, collect data about internal capacity, e.g. inventory capacity, manufacturing and logistics and supply chain capacities. Within this step, the MRP system is often used to establish a description of future plans and requirements (Grimson & Pyke, 2007). Then, using the demand plan as input, the best alternatives are analysed according to the business plan regarding profitability, revenue and customer service. Constraints and capacity opportunities should be identified. Within this step agility and flexibility regarding product supply should be considered, in order to minimize the impact of forecast errors (Cecere et al., 2009). The goal of this step is to create the initial supply plan, designed to meet the forecast requirements (Cecere et al., 2009).

3. Develop a final consensus operating plan

Step 3 includes a meeting between representatives from Sales, Marketing, Operations and Finance to develop the final demand and supply plan that sets guidelines for the upcoming cycle. It should balance the supply and demand plans, while reaching the overall business and strategic goals. This also contains scenarios and consequences regarding possible risks. Afterwards, management should approve the agreed plan and set out the necessary actions (Grimson & Pyke, 2007).

It is necessary for S&OP teams to be cross-functional, as it enhances effectiveness (Kruse, 2004). In addition, it is highly recommended that meetings between team members occur on a regular basis, with a monthly schedule being the most common used interval (Kruse, 2004) (Grimson & Pyke, 2007).

4. Communicate and implement plan

In the fourth step, the final agreed S&OP plan is communicated to all involved parties and eventually implemented. Sales and Marketing should be aware of the quantities they agreed to sell, while the operations departments are compromised to make sure that all the volumes are produced and delivered on time (Grimson & Pyke, 2007). External communication is also a possibility in this step.

5. Measure process performance

The performance of S&OP should be measured so it can be improved over time (Lapide, 2004). Therefore, the fifth and final step aims at measuring and controlling the effectiveness of the plans and the S&OP process itself through KPIs. These KPIs include operational as well as commercial indicators and must be shared between the involved departments (Grimson & Pyke, 2007).

Additionally, since the S&OP process is usually conducted following a recurring monthly schedule, the process can be seen as a cycle. Although the processsteps are generally the same, the cycle also distincts two meetings. The first meeting is called ‘pre-S&OP’ and relates to the alignment between the demand plan and supply plan and thus leads to the creation of the final operating plan, while also financially reviewing the plan. The second meeting is the executive S&OP meeting. During this meeting key decisions are made regarding the business strategy in combination with balancing supply and

demand. Simultaneously, the previous month is reviewed in order to improve the process (Kumar, 2016) .

A S&OP process increases its added value to organisations, in other words, achieves higher maturity, when “both demand and supply become committed to the process and contribute to demand and supply goals and volume plans, resulting in a coordinated supply chain that is planned and executed in a synchronized way” (Jonsson et al., 2021). According to Ávila et al. (2019), a maturity model can be defined as a “staircase that describes how companies manage a certain area of their business”. The objective of these models is to assess what stage the company is currently in and what is needed to reach the next stage. The maturity model used by Ávila et al. (2019) is based on Prokopets (2012) and consists of four stages, namely, marginal process, rudimentary process, classic process and ideal process. The first stage is the least advanced, while the latest stage is perceived as almost impossible to achieve, with companies being best in class, becoming a benchmark (Ávila et al., 2019). The model is showed in the table below.

Table 3: Four-stage S&OP process maturity model

	Stage 1 Marginal Process	Stage 2 Rudimentary Process	Stage 3 Classic Process	Stage 4 Ideal Process
Meetings	Informal meetings	Routine schedule	100% attendance and participation	Event-driven meetings
	Sporadic scheduling	Spotty attendance and participation		
Plans Alignment	Disjoint demand plans	Demand plans reconciled	Demand and supply plans jointly aligned	Demand and supply plans aligned internally and externally
	Supply plans not aligned to demand plans	Supply plans aligned to demand plan	External collaboration with limited number of suppliers and customers	External collaboration with most suppliers and customers
Technologies Used	Minimal technology-enablement	Standalone multifacility APS system	Demand planning packages and supply planning applications integrated	Advanced S&OP workbench
	Multitude of spreadsheets	Standalone demand planning system	External information manually brought into the process	External-facing collaborative software integrated to internal demand-supply planning systems
		Systems interfaced in a one-way basis		

2.5 Purchasing and Supply Management (PSM)

Researchers have recognized the changing and evolving role of purchasing and supply management. In the current uncertain market environment, PSM contributes to business success on multiple dimensions. Also, literature supports PSM's development into a more strategic role (Murfield et al., 2021).

According to van Weele (2010), the discipline of purchasing and supply management can be defined as the "discipline that is concerned with the management of external

sources (goods, services, capabilities and knowledge) that are necessary for running, maintaining and managing the primary and secondary support processes of a firm at the most favourable conditions". Usually, there are 3 core processes within purchasing to achieve this goal, namely, supplier management, purchase-to-pay and source to contract. Supplier management includes supplier selection, (strategic) evaluation, development and, if needed, phasing out of suppliers. Purchase-to-pay contains a process from first initial purchase requisition up to order creation and payment. Source to contract consists of 2 major processes, i.e. project purchasing and global sourcing (Mohr & Holtrup, 2019). The Purchasing and Supply Management function is initially concerned with the recognition of a certain need, searching and selecting suppliers, managing contracts and payments, as well as, delivery of materials. However, further responsibilities include warehousing, inventory management, scheduling and material management. Besides the operational responsibilities, there are strategic responsibilities regarding purchasing and supply. These contain, among others, supplier relationships, technological developments and market trends (Johnson, 2019).

Although there are other important purchasing and supply objectives, e.g. quality, flexibility and on time delivery, cost management and reduction is traditionally considered the most crucial one regarding purchasing performance (Baier et al., 2008; Zsidisin et al., 2003). According to van Weele (2018), this is not a surprise as the costs of goods and services accumulate for the biggest share of the total costs. However, nowadays the function has also obtained a strategic role partly due to the increased outsourcing of business activities (van Weele, 2018; Zsidisin et al., 2003). Aditionally, the strategic role has become necessary since the purchasing and supply departments face challenges which are able to significantly affect the business in general. These challenges include risk management, sustainability and technological challenges (Johnson, 2019).

3. Theoretical Framework

So, summarizing the theories mentioned in the literature review, the goal of a Sales and Operations Planning process is to horizontally align supply and demand, while simultaneously vertically aligning business strategy and operational planning and execution (Ávila et al., 2019; Tuomikangas & Kaipia, 2014; Pereira et al., 2020; Jonsson et al., 2021). The subsequent goal is to manage unplanned variation in material flows along the supply chain, addressing vertical and market volatility. Additionally, a S&OP process is described as a support for maximizing opportunity, minimizing risks, while providing organisations with the ability to make trade-offs based on profitability (Ávila et al., 2019). Meanwhile, the S&OP process provides firms with benefits as it helps companies to improve the accuracy of their forecast and reduce stock levels. In addition, it improves the on time delivery and reduces supply chain costs (Hinkel et al., 2016). Besides, it is expected to be a key enabler of growth, has a positive effect on sales and increases revenues (Hirneisen, 2017). Finally, a Sales & Operations Planning process streamlines communication and improves the flow of information within a company (Ávila et al., 2019; Enchange, 2021; Heizer et al., 2016). According to Jonsson et al. (2021), there are multiple factors that need to be addressed in order to achieve a successful S&OP. These can be categorized as external and internal factors. The planning environment for S&OP has been affected by an increasing number of external factors including globalisation, global or local crisis with a global impact, technological improvements and supply and demand volatility. Various internal factors have implications on the performance of S&OP. These consist of objectives, e.g. cost reduction, the translation from planning to operational execution, but also the lack of alignment and communication within organisations (Wilson & Raman, 2017; Cecere, 2015; Jonsson et al., 2021).

To address these issues and enable companies to benefit from advantages and achieve goals regarding S&OP, it is necessary to conduct Sales and Operations Planning following a stepwise process, consisting of 5 main steps. These include the creation of demand forecast, supply plan and operating plan, communication and implementation of the final plan and measuring performance of the process. The process increases its added value to the organisation, in other words, achieves higher maturity, when “both demand and supply become committed to the process and contribute to demand and supply goals and volume

plans, resulting in a coordinated supply chain that is planned and executed in a synchronized way" (Jonsson et al., 2021).

The combination of these theories resulted in the proposed framework as can be seen in figure 1. The framework was build with the core focus on the five process steps as defined by Ávila et al. (2019), based on Grimson & Pyke (2007), Cecere et al., (2009), Lapide (2004) and Lapide (2004). The first four steps are displayed in the middle of the figure ordered sequentially and are necessary to execute in a Sales and Operations Planning process and enables organisations to benefit from the advantages S&OP involves. The fifth step however, is placed above the four steps. This has to do with the measurement of performance of the process in general, but also the performance of every single step alone. According to Cecere et al. (2009) measurement of a S&OP process should be done through forecast accuracy, stock levels, on time delivery, costs, sales and revenue as performance indicators. Simultaneously, according to Ávila et al. (2019) and Prokopets (2012), it is necessary to assess maturity of the process and define what is needed to achieve the next stage of the maturity model as discussed by Ávila et al. (2019) and Prokopets (2012) in order to improve the added value of the process. Therefore, factors regarding maturity are included in the model and consist of meetings, plans alignment and technologies used (Ávila et al., 2019; Prokopets, 2012).

The arrows between the four steps in the middle and step 5 placed above, represent the expected effect of the performance measurements and indicators on the first four steps of the Sales and Operations Planning process. It is expected that the performance of the demand plan is measured through the accuracy of the forecast, while the supply plan is expected to be measured through the amount of stock levels and on time delivery of the company. It is expected that the performance of the operating plan and process in general is measured through costs, sales and revenues, as well as forecast accuracy. Besides, the arrows between the four steps in the middle and maturity placed below, represent the effect of process maturity on the S&OP process and its added value to the organisation. So these mainly focus on the process in general. It is expected that the maturity and added value of the Sales and Operations Planning process can be assessed through meetings, plans alignment and technologies used in the process. Meetings relate to the frequency and attendance of meetings, while plans alignment regard the alignment between demand and supply plans, not only internal to the company, but also external to suppliers and

customers. Technologies used includes what system, software or application is used in the internal and external communication and implementation of the process.

The framework designed as a process model, including steps, performance measurements and maturity assessment is expected to lead to a well established process with horizontal and vertical alignment and management of vertical and market volatility as a result.

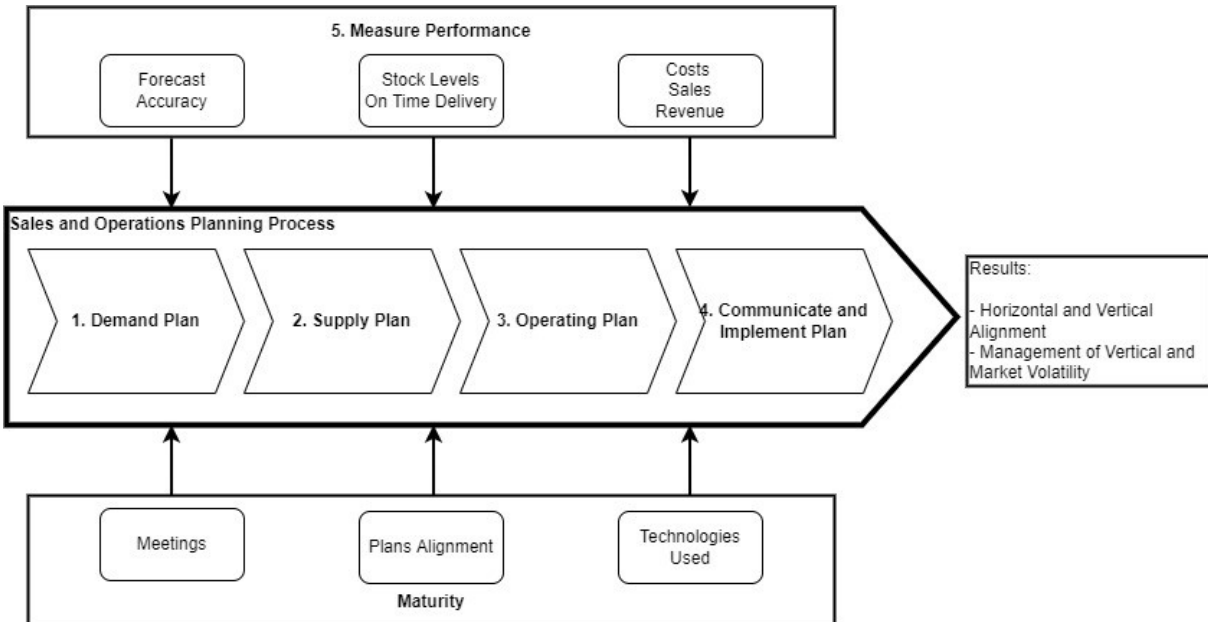

Figure 1: Theoretical Framework S&OP

4. Research Methodology

4.1 Research Design

The aim of this study is to identify how a Sales and Operations Planning process should be designed in order to address uncertainty in a make-to-order environment. Classical research is usually focused on building and testing theories in order to understand and explain phenomena through descriptive knowledge. However, van Aken (2004) argues that “understanding a problem is only halfway to solving it”. This research will be partly conducted through the principles of design science research. Steps that will be followed from design research are identifying and clarifying the problem and designing a solution (Sein et al., 2011; Alturki et al., 2011; Dresch et al., 2015; Gregor & Hevner, 2013; Peffers et al., 2018).

This research will be performed as a case study at a company. The main advantage of a case study is that it allows to use a variety of research methods depending on the circumstances and specific needs of the situation. A case study characteristically emphasizes an in-depth study, focussing on relationships and processes in a natural setting (Denscombe, 2014). According to Denscombe (2014), a case study is a technique that focuses on a specific phenomenon. It can be defined as an “in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution, programme or system in a ‘real life’ context. The primary purpose is to generate in-depth understanding of a specific topic, programme, policy, institution or system to generate knowledge and/or inform policy development, professional practice and civil or community action” (Thomas, 2015; Simons, 2009). Additionally, a case study investigates one case or a small number of cases. Data is collected and analysed about a large number of features of the case or cases while studying naturally occurring cases in which variables will not be controlled (Hammersley et al., 2000). However, since a case study is about the particular, rather than the general, and so, generalisation from a case study is not possible (Thomas, 2015; Creswell et al., 2007).

Besides, this research can be seen as ‘real world research’. This implies that applied research is combined with academic research. So, during this research, personal experience, social life and social systems will be examined to understand the reality perceived by people and its consequences (Robson & McCartan, 2016). In addition, this research focuses on a single, specific problem within one company, making it a unique

single case study (Stake, 1995). By selecting the company as a case for the research, the boundary of the case is set at all the stakeholders of the company's current forecasting process. The involved departments are Purchase in particular, but also Operations, Sales and Management. The company also functions as research location. The stakeholders will be interviewed as part of data collection. By doing so, qualitative data based on personal understandings can be gathered about the design of a S&OP process as a forecasting tool within a social system in the form of the case company. As a result, an ideal S&OP process can be designed for the case company, which is based on academic literature, the theoretical framework and personal motives and perspectives of employees of the company.

4.2 Data collection

Quantitative research is associated with the collection of numerical data, while in qualitative research data is collected via observations and interviews (Bryman, 2012). Considering the qualititative characteristics of this research, interviews will be conducted and used as data collection method. The sampling frame for the interviews consists of the internal stakeholders of the Sales and Operations Planning process.

These interviews are conducted to gain understanding of motives, willingness and different perspectives regarding S&OP. Combining the interviews with academic literature from the literature review and the established theoretical framework will lead to the design of an ideal Sales and Operations Planning process, so uncertainty in a make-to-order environment can be addressed.

Interviews provide the researcher with the ability to explore reasoning behind arguments and gives the advantage of gaining knowledge about a subject that goes beyond describing. Quantitative research methods are less suitable in a qualitative environment, since full information can not be obtained and it is difficult to gather explanations (Weiss, 1995). Additionally, the interviews with the stakeholders will be conducted with one individual at a time, instead of group interviews. This is mainly, because group interviews make it harder to ask follow-up questions and individual interviews eliminate the effect of group thinking. So responses are not affected by other respondents. The interviews will be semi-structured, meaning that the interviews will be prepared guided by identified themes in a systematic manner designed to elicit elaborative answers and allow follow-up

questions (Qu & Dumay, 2011). According to literature, stakeholders of a S&OP process are the departments Sales, Marketing, Development, Manufacturing and Sourcing. Translating this to the current situation regarding forecasting and future S&OP process at the case company leads to 9 stakeholders from the departments Sales, Operations and Purchase. Sales represents Sales and Marketing, while Operations represents Manufacturing. Sourcing is being represented by the Purchase department. Currently, Development is not represented. This is because of the current organisational structure of the case company including responsibilities of the department. The stakeholders are displayed in table 4, which also shows the duration of each interview.

Table 4 Respondents interviews

Respondent	Department	Interview Duration
Interviewee 1	Purchase	21:55
Interviewee 2	Purchase	46:19
Interviewee 3	Purchase	32:58
Interviewee 4	Sales	30:27
Interviewee 5	Sales	32:17
Interviewee 6	Sales	41:01
Interviewee 7	Sales	28:22
Interviewee 8	Operations	32:02
Interviewee 9	Operations	32:06

4.3 Development of the semi-structured interview questions

According to Kallio et al. (2016), the result of a case study is very dependent on the quality of the interviews. In order to guarantee high quality interviews, an interview protocol has been established. The interview protocol can be found in appendix A. To start the interview, introductory questions were asked to gain a better understanding of the interviewee and their base knowledge on forecasting and Sales and Operations Planning.

The main part of the interview consisted of questions regarding the perspective of the interviewee on Sales and Operations Planning as a forecasting process to improve alignment between supply and demand and address uncertainty in a make-to-order environment. These questions cover the S&OP process in general, but also the design of the most desirable S&OP process for the case company within a make-to-order environment. Simultaneously, subjects regarding the establishment of a S&OP team

including responsibilities, required inputs/outputs for the process and measurement, analysis and maturity of the process are covered.

The questions in the semi-structured interview are based on existing theory in combination with the established theoretical framework and specific characteristics of the company in the case study. The interview guide for the semi-structured interviews can be seen in appendix B.

4.4 Data analysis

After conducting the interviews, the interviews were transcribed. The transcription could then be used for data analysis. To analyse the interviews, the program Atlas.ti was used, in which is it possible to code and analyse multiple interviews simultaneously. Coding is a process which is used to identify concepts in data and is perceived as main analytical process (Maher et al., 2018). The codes were used to sort the acquired data. The different codes were defined based on theory as explained in the literature review. During the analysis of the qualitative data gathered through the interviews and assigning of the codes, keywords were defined. Besides, within the analytical process it is important to constantly compare data with data and data with the defined codes, concepts and keywords (Maher et al., 2018).

Within the data analysis, in general, there was searched for similarities and differences between respondents regarding codes, keywords and concepts on, among others, the design of a Sales and Operations Planning process. More specifically, during the interviews and coding of the interviews there was searched for factors regarding performance, measuring and maturity of the model. Regarding performance of the model, there was searched for ideal inputs from Sales, Operations and Purchase, required output, product level, time horizon, communication and implementation and stakeholders and their responsibilities. Considering measuring the model, there was searched for performance indicators and methods to conduct measurements and analysis of the model and process. Regarding maturity of the model, there was searched for regularity of meetings and attendance of stakeholders in these meetings. Besides there was searched for additional findings on personal perspectives regarding current forecasting methods, challenges and (dis)advantages of S&OP. This was mainly done through transcription and coding of the interviews. During the coding process, a combination of inductive and

deductive coding was used. By doing so, codes are “completely loyal to the data”, while simultaeously maintaining focus on “issues that are known to be important in the existing literature” (Linneberg & Korsgaard, 2019).

In the end, findings from the interviews were combined with the established theoretical framework and literature review, resulting in the design of a thorough Sales and Operations Planning process in order to address uncertainty in a make-to-order environment.

Additionally, reliability and validity of a research are essential to consider when conducting research. According to Andrade (2018) reliability describes “the consistency with which results are obtained”. Validity means that the research is measuring what is intended to be measured (Fitzner, 2007). In order to guarantee research reliability and validity, standardized research protocals and questions were used during the interviews. These were mainly based on findings from the literature review. To increase reliability, all interviews were listened to and read again to correct possible mistakes in the transcriptions. To increase validity, results of the interviews were shared with the participants, so these could be validated. To decrease bias, the questions were asked in the same order and no evocative questions were asked. Simultaneously, the number of participants and the participants themselves were selected carefully.

5. Results

In order to gain understanding of motives, willingness and different perspectives regarding S&OP, so the most suitable S&OP orientation for a make-to-order environment can be understood, interviews have been conducted. During the interviews, interviewees were asked questions about different factors and elements regarding Sales and Operations Planning. These questions were inspired by the literature review, the established theoretical framework and the interpretation thereof and focus on execution of the model, measuring the model and maturity of the model. At first, results from the interviews regarding execution of the model are discussed. This includes the steps of an ideal process, stakeholders' roles and their responsibilities, time horizon and regularity of the process, product level, input from the sales, operations and purchasing departments, as well as the required output of the process. Secondly, measuring, analysing and maturing the model is discussed. This part consists of measuring and analysing the process. Third, additional findings are discussed consisting of challenges regarding S&OP in a make-to-order environment. Finally, the theoretical framework is rebuild. By doing so, the results from the interviews can be combined with literature and illustrated in the framework so an ideal Sales and Operations Planning process for companies in a make-to-order environment could be designed. Within this process, the creation of the demand plan, supply plan and operating plan is accounted for. This also applies for the implementation and communication of the multiple plans and analysis and measurement of the process steps and the process in total.

The different codes which were used regarding execution of the model, measuring, analysis and maturity of the model and additional findings can be seen in tables 5, 6 and 7.

Table 5: Codes regarding Execution of the model

Execution of the model		
First Order Codes	Second Order Codes	Third Order Codes
Ideal process	Ideal process	
	Input Purchasing/Supply	
	Input Operations	
	Input Sales	
	Output	
	Rolling	
	Stakeholders of an ideal process	
Product level	Article	
	Machine	
	Module	
Regularity	Frequency	Yearly
		Quarterly
		Monthly
Sales and Operations Planning	Definition	
	Process steps	
	Advantages	
Stakeholders' roles	Business Unit Manager	
	Purchasing	
	Operations	
	Planning	
	Product Management	
	Sales	
	Supply Chain	
Time horizon	S&OP length	0-2 months
		3-6 months
		6-18 months
Responsibility	Process	
	Process steps	

5.1 Steps of a S&OP process

After the introductory questions were discussed, interviewees were asked questions about the steps regarding a Sales and Operations Planning process. As previously discussed, S&OP is perceived as a standardized process with a structured set of process steps. These steps consist of the development of the demand, supply and operating plans, communication and implementation of the final plan and measurement of the process and process steps. During the interviews it became clear that the standardized process steps do not need to be changed for a company in a make-to-order environment. Interviewee 3 even stated that S&OP "is a proven method in which the most important factors are considered" and "I don't see why we would differ from other organisations in this. Although, company specific factors should be taken into account" (Interviewee 3).

5.2 Stakeholders' roles and their responsibilities

As discussed in the literature review, a Sales and Operations Planning process usually consists of Sales, Marketing, Development, Manufacturing and Sourcing as stakeholders. In the previous chapter, this was translated to the stakeholders from the case company, meaning the sales, operations and purchasing departments were involved. However, from the interviews has emerged that the roles of Product Management and Business Unit Management also should be involved in the Sales and Operations Planning process, since these functions "are responsible for managing the product portfolio" (Interviewee 7).

During the interviews it became clear that each department is responsible for their own input to the process. What this input is, is discussed later on. However, the different stakeholders agreed on the fact that one person should be appointed to be responsible for the total process in general. Data analysis of the interviews showed that the Supply Chain Engineer within the purchasing department of the company should have this responsibility. Since this is a function "that can transcend departments, has decision-making authority and is able to involve stakeholders in the process" (Interviewee 8). In addition, Interviewee 6 stated that this person "should also be the initiator of the improvement of the process" (Interviewee 6).

So, this means that the Sales Director, Teamleader Sales Support, Business Unit Manager and Product Manager are responsible for the demand plan. Subsequently, the other stakeholders from the operations and purchasing departments are responsible for the supply plan, while all the stakeholders together are responsible for the establishment of the operating plan and the communication and implementation of this plan. At the end, the Supply Chain Engineer is responsible for the total process including measuring, analysing and improving this process.

5.3 Horizon and regularity

Analysed data showed a clear perspective regarding the horizon of the S&OP process. According to the interviewees, a time span of 12 months is most relevant. Interviewee 3 stated that "we should have a forecast for 12 months, since we have to initiate the purchase of some components a year ahead, because of the lead time and in order to have the component on time for start of production" (Interviewee 3). Furthermore, interviewee

4 and 6 argued that every time the S&OP process is reviewed, the focus should still be 12 months ahead (Interviewee 4; Interviewee 6). In other words, a S&OP process containing a rolling principle is preferable, continuously looking 12 months into the future.

During data analysis, the regularity of the process was still debatable. A quarterly schedule of the process is preferred by the interviewees over a monthly cycle, but only slightly. Interviewee 3 argued the following regarding the utilisation of a quarterly cycle (Interviewee 3):

> *"The more info, the better. But I think that if you look a bit further ahead, so if you do that every three months (the meeting), more complete information will come out. If a sudden spike in demand or supply happens in week two and a decline takes place in week three and four, then those ups and downs will level out. So, there will be less panic. As a result, it makes sense to spread the meeting out over the time."*

However, the use of a quarterly cycle would lead to an adaptation of the process, compared to the process as described in literature. Besides interviewee 1 stated the following regarding the utilisation of a monthly cycle (Interviewee 1):

> *"I think that is most useful, because when using a quarterly cycle, there is too much variation. A lot can happen within a month, see Covid, see the Ukrainian-Russian war. If that happens, then we will be three months behind and things go wrong. So we have to stay on top of it and I think monthly is just good enough then."*

So, to conclude, monthly and quarterly cycles both have advantages and disadvantages. However, since literature prescribes monthly cycles, companies in make-to-order environments should at least start with a Sales and Operations Planning process in a monthly cycle. Besides, a monthly cycle will provide companies with the opportunity to measure, analyse and improve the process more quickly, since it leads to 12 points of measurement during the year, instead of 4. Subsequently, by meeting every month, the company will be able to anticipate short term changes in its environment.

5.4 Product level

During the interviews it became clear that it is desirable to deepen the current forecast on machine level to the module level, because "historical data on module level is already

available" (Interviewee 6). This is needed so "a more accurate forecast can be achieved" (Interviewee 3). Additionally, interviewee 4 stated the following (Interviewee 4):

> *"Two years ago, lead times of components were short enough that if a machine was sold, the components could be obtained on time. In 2022, this is no longer the case. Lead times of components have become so long that is has become necessary to forecast modules as well"*

By doing so, the case company, especially the operational departments, gain insight in components existing in modules. As a result, the case company is enabled to manage lead times and improve inventory management regarding components, in particular the components with long lead times. Additionally, interviewee 8 stated that "for now, the best improvement is to, as quickly as possible, give up on inventory of complete modules and work towards inventory management on component level. I think that is where we can achieve the biggest advantages" (Interviewee 8).

So, it can be concluded that the S&OP process needs to be adapted to the company, since a more in-depth forecast on the module level is wished for, while simultaneously improving the management of lead times and inventory.

5.5 Input Sales

At first, it is Sales' responsibility to feed the S&OP process with market information on customer demand and potential sales as "Sales needs to conduct good and thorough market research and in addition, the data needs to be properly documented. So, what we can then expect from them is, at module level, what will be needed in the next x-amount of months, preferably as far ahead as possible" (Interviewee 3). Second, interviewees stated that the Sales department should provide the "expected sales numbers on machine and module level" (Interviewee 1; Interviewee 2; Interviewee 4; Interviewee 9), besides this forecast should look 12 months ahead (Interviewee 2; Interviewee 4). Subsequently, the forecast should be based on historical data (Interviewee 1; Interviewee 2; Interviewee 6). Finally, Sales should identify and communicate what lead times regarding total machines are acceptable (Interviewee 9), so the case company can stay competitive and achieve or increase competitive advantage.

Concluding, Sales should provide the stakeholders and the S&OP process with market information on customer demand, expected sales numbers on machine and module level for the next 12 months based on historical data and acceptable lead times.

5.6 Input Operations

The main part that is needed from Operations in the Sales and Operations Planning process is information on production capacities, in other words the amount of machines that can be produced in a certain timeframe. After Sales provided the information regarding the expected sales numbers, it is Operations' responsibility to feed the process and stakeholders of the process with information regarding production capacities (Interviewee 1; Interviewee 2; Interviewee 3). As interviewee 2 stated that Operations should "specify what production capacity is available to build a certain machine or module" (Interviewee 2). This also includes labour hours, testing capacity and installation of the machines on site (Interviewee 1; Interviewee 2; Interviewee 3). Regarding the input of the Operations department, interviewee 3 stated the following:

> *"We are talking about production capacity in particular, but also everything behind it. Operations has to monitor the long term, so they have to be able to identify possible issues. Do we have enough people at work within the coming three months to build the machines? Operations has to provide information on that subject. They have to consider the planning, purchase of materials, but also the installation of the machines, because we can only install an x-x-number of machines at once. Is the rest of the organisation ready if we see sudden increase in demand?"*

Besides, Operations should identify how to manage inventory through stock levels including safety stocks and assure actual production of machines sold by Sales (Interviewee 5; Interviewee 6; Interviewee 9).

So, in short, the input of the Operations department should provide the process and the stakeholders with numbers regarding available production capacity including labour hours, testing capacity and installation of machines, while also managing the inventory through stock levels and safety stocks. In the end, Operations should be able to guarantee actual production of the machines that have been sold.

5.7 Input Purchasing

From the interviews, it became clear that the purchasing department is responsible for feeding the Sales and Operations Planning process and its stakeholders with information on the supply market that includes lead times of components. Interviewee 3 stated that "We are in contact with our suppliers, we have information on lead times and possible expectations. We should feed the rest of the organisation with this information, so they can make thorough decisions" (Interviewee 3). Regarding lead times, the delivery of reliable and up to date data on lead times of each component is perceived as most important input from the purchasing department (Interviewee 2; Interviewee 3; Interviewee 8; Interviewee 9). Interviewee 6 added that Purchasing should provide a radar in which the term 'long lead item' is defined and long lead items are identified (Interviewee 6). By doing so, Operations is enabled to improve inventory management based on consumption and time needed to replenish stocks, while lead times of the machines in total can be given more accurate. However, in the end, the most important responsibility of the purchasing department is the timely delivery of materials for production and to meet demand (Interviewee 1; Interviewee 6).

To conclude, the purchasing department should provide the S&OP process and its stakeholders with information on the supply market, lead times, long lead items and after all assure timely delivery of materials.

5.8 Output

The required output of the Sales and Operations Planning process is a clear operating plan and planning between Sales and Operations, which satisfies every stakeholder (Interviewee 2). Interviewee 9 added that the process should "function as a 'handshake' between Sales and Operations" (Interviewee 9). The process should lead to a forecast on a modular product level which contains a period of 12 months ahead (Interviewee 3), based on historical data including continuously updated knowledge on the supply and demand market. Simultaneously, data and information regarding Sales and Operations Planning as a process in general, as well as the single steps should be well documented and, if possible, visualized in an automated system (Interviewee 6; Interviewee 9). This should take place in the ERP-system or Power BI. The end goal of the S&OP process should be the timely delivery of machines with beneficial and competitive lead times, ideally

reduced to 12 weeks, with as little ‘hick-ups’ as possible (Interviewee 1; Interviewee 4; Interviewee 5), while leading to improved communication between the different departments and stakeholders (Interviewee 9).

Concluding, the Sales and Operations Planning process should lead to a forecast on the modular product level for the next 12 months, based on historical data and knowledge on the supply and demand market. This information and data should be well documented and communicated, functioning as a ‘handshake’ between Sales and Operations. So, in the end, machines can be delivered timely and lead times can be reduced.

Table 6: Codes regarding Measuring and Maturity of the model

Measuring and Maturity of the model		
First Order Codes	Second Order Codes	Third Order Codes
measuring / analysing		

5.9 Measuring, analysing and maturity the process

After the S&OP process is implemented, it is key to measure and analyse it. By doing so, the process can be improved and simultaneously a higher maturity can be achieved. However, during the interviews no clear performance indicators were mentioned. Nevertheless, interviewees agreed on the importance of measuring and analysing the Sales and Operations Planning process. As interviewee 9 stated “I would just execute the process for an entire year, and then collect data how the reality compares to the forecast. And then do a GAP analysis and look at what we can improve” (Interviewee 9). Interviewee 3 added “if it does not have the desired results, we have to go back to the drawing board and fine-tune until it does have the desired results. It is trial and error to discover what works best for us” (Interviewee 3).

Regarding maturity, interviewee 1 expressed his wish for external communication of the plan. As he stated, “what I would like is to share this with suppliers to see if they can keep up with our growth” (Interviewee 1). Besides, interviewee 1 highlighted the necessity to include Research & Development, however, the process needs to be mature enough to include new product developments and phase-in, phase-out processes in S&OP. Additionally, interviewee 6 stated that “the basis of the forecast should be an automatically filled system based on data instead of gut feeling” (Interviewee 6).

In short, although no clear performance indicators were mentioned, interviewees agreed on the importance of measuring and analysing the process. Being it through fine tuning and trial and error leading to GAP analysis.

Table 7: Codes regarding Additional Findings

Additional Findings		
First Order Codes	Second Order Codes	Third Order Codes
Forecasting	Current process	
	Disadvantages	
	Challenges	
	Advantages	
High mix, Low volume		

5.10 Challenges regarding S&OP in a make-to-order environment

In general, forecasting through a Sales and Operations Planning is a challenging process. However, this is increasingly the case for companies in a make-to-order environment. At first, this has to with the high mix, low volume product portfolio, which is typical for companies with MTO as manufacturing strategy. Simultaneously, interviewees experienced additional challenges regarding forecasting in a make-to-order environment at the case company. Interviewee 9 called attention to the high value products used in the case company, while also addressing challenges regarding updates on machines. As Interviewee 9 stated the following (Interviewee 9):

> *"Ultimately, the biggest challenge is that, on one hand, you want to guarantee short lead times and, on the other hand, you do not want to have infinite obligations in your supply chain and keep your inventory as low as possible. Besides, it is challenging to forecast, because you do not want to have that much value on stock, while we also have to deal with updates and changes on our products"*

Besides, interviewees 1, 3, 6 and 7 highlighted components with long lead times as challenge considering forecasting and S&OP (Interviewee 1; Interviewee 3; Interviewee 6; Interviewee 7). Geared motors are an example of this, with lead times of approximately one year. Also, the respondents from the sales department named product customisation by customers as main challenge in the S&OP process for the case company. This is because customer specific components are most difficult to forecast. Interviewee 3 added,

“it is challenging when a machine is sold with a lead time of 30 weeks, while these specific components have a lead time of 40 weeks” (Interviewee 3). This, however, could be expected as customisation is in line with characteristics concerning make-to-order as a manufacturing strategy.

Therefore, it can be concluded that establishing a Sales and Operations Planning process is a challenging task, especially for companies in a make-to-order environment. This relates to the utilisation of a high mix, low volume product portfolio and the possibility for customers to modify and customise the end product. Additionally, these types of companies often suffer from long lead times on components, which also complicates the S&OP process.

5.11 New framework

In the third chapter, the theoretical framework was build. Multiple theories as discussed in the literature review were combined, resulting in the model as showed in figure 1. However, the current model solely has a theoretical perspective. After conducting, transcribing and coding the interviews, a practical perspective from a make-to-order environment could be added. By doing so, theoretical and practical knowledge, perspectives and insights could be combined, leading to a renewed framework so an ideal Sales and Operations Planning process can be designed for companies in a make-to-order environment.

The interviews resulted in new findings which changed variables of the theoretical model and its meaning, leading to a more comprehensive framework, as displayed in figure 2, which can be used to design an optimal process regarding S&OP. The figure based on findings from the interviews differs from a traditional Sales and Operations Planning process, as established in academical literature. The framework differs regarding execution of the steps, time horizon and measurement and analysis of the process and process steps. The framework also differs in relation to the stakeholders, although these are not visible in the framework.

As previously discussed, Sales should provide the stakeholders and the S&OP process with market information, expected sales numbers on machine and module level for the next 12 months based on historical data and acceptable lead times. By doing so, the demand plan can be established. Besides, in order to establish the supply plan the input of

the operations department should mainly consist of overall production capacity and guarantee actual production, while the purchasing department should provide information on the supply market, lead times, long lead items and assure a timely delivery of materials. Combining the input from Sales, Operations and Purchasing will lead to a thorough operating plan in which machines and modules are forecasted for the next 12 months ahead, based on historical data and knowledge on the supply and demand market. In addition, performance of the process should be measured following a trial and error approach in which reality is compared with the forecast based on collected data, leading to a GAP analysis exposing improvements. Subsequently, it is important that this information is communicated and implemented, but also well documented. So, in the end, machines can be delivered timely and lead times can be reduced. This will result in the achievement of horizontal and vertical alignment and an improved management of vertical and market volatility. By doing so, uncertainty in a MTO environment can be addressed.

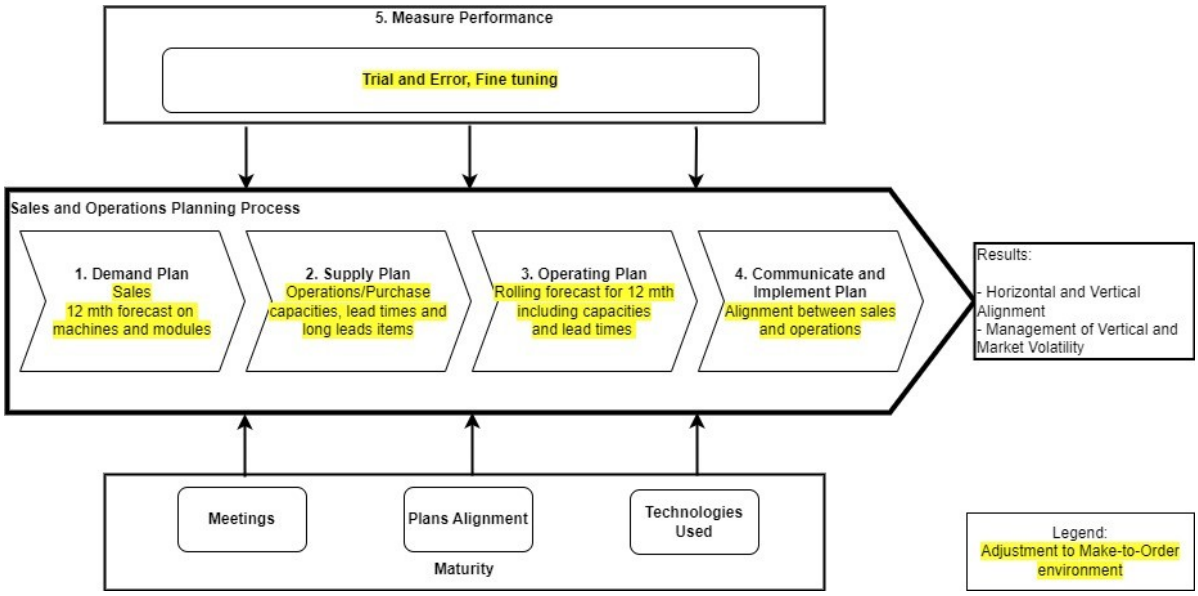

Figure 2: New framework

6. Discussion

During this research, the goal was to identify how a Sales & Operations Planning (S&OP) process should be designed in order to address uncertainty in a make-to-order environment. For this purpose, the following research question has been formulated: *How should a Sales and Operations Planning (S&OP) process be designed in order to address uncertainty in a make-to-order environment?* In this chapter, the literature review will be compared to the results from the interviews. During the research and interviews, it became clear that there is much overlap between academic literature and findings from the case study. However, the process always needs certain adjustments in order to fit within company specific characteristics.

The results of the interviews indicate that, in order to address uncertainty in a make-to-order environment, the Sales and Operations Planning process should be designed according to the step-wise process as established by Ávila et al. (2019) and consists of the following steps:

- Creation of the unconstrained demand forecast
- Creation of the initial supply plan
- Development of the final operating plan
- Communication and implementation of the final plan
- Measurement of process performance

Sales and Operations Planning as a forecasting tool including its process steps is a well proven method which is almost universally applicable. However, companies in a make-to-order environment should review the process before implementation, so it fits within company specific characteristics. According to the results, variables in relation to the stakeholders, execution of the steps, time horizon and measurement and analysis of the process and process steps should be designed diffently compared to the standardized design as established in academic literature.

Shedlawski (2017) and Ávila et al. (2019) identified the departments of sales, marketing, development, manufacturing, sourcing and finance as main stakeholders within the S&OP process. This was translated to the stakeholders from the case company meaning the sales, operations and purchasing departments were involved. However, from data analysis has emerged that the specific roles of Product Management and Business Unit Management also should be involved in the process at the case company. To

summarize, the general stakeholders as identified by literature always need to be reviewed in order to fit within characteristics and roles specific to a certain company.

According to Ávila et al. (2019), Grimson & Pyke (2007) and Lapide (2004), the first step of the process, the creation of the demand plan, is typically performed by the Sales and Marketing departments. However, the results indicate that Sales, single-handedly, is responsible for the completion of the demand plan. Providing market information, expected sales numbers on the machine and modular product level for the next 12 months based on historical data and acceptable lead times as input. The second step, the creation of the supply plan, is usually conducted by operations/supply chain teams (Ávila et al., 2019; Cecere et al., 2009). However, the results show that the operations and purchasing departments are responsible for this step. Contributing overall production capacity, inventory management, guarantee actual production, information on the supply market, lead times, long lead items and assure timely delivery of materials to the S&OP process. According to Ávila et al. (2019), Grimson & Pyke (2007) and Cecere et al. (2009) the third step, developing the final operating plan, is typically performed by a S&OP team consisting of representatives from Sales, Marketing, Operations and Finance. However, the results indicate that the team should consist of representatives from the sales, operations and purchasing departments.

According to Heizer et al. (2016) and Pereira et al. (2020) Sales and Operations Planning is concerned with the intermediate future, in other words, 3 to 18 months ahead. Results from the interviews indicated that 12 months ahead is most relevant for companies in a MTO environment.

According to Ávila et al. (2019) and Lapide (2004), during the fifth step of the process, the process steps and the process in general are measured and analysed through KPIs including commercial as well as operational performance indicators. Examples of KPIs are forecast accuracy, stock levels, on time delivery, costs, sales and revenue (Grimson & Pyke, 2007). However, data suggests that measurement, analysis and improving the process within companies in a make-to-order environment can best be done from a trial and error perspective, leading to fine tuning based on GAP analysis.

To conclude, in order to address uncertainty in a make-to-order environment, companies should design a Sales and Operations Planning process according to the standardized steps as discussed in academic literature. However, the process can not be

blindly copied, since the process needs to be reviewed first before implementation, so it will fit within company specific characteristics. Factors that should be reviewed in any case are the stakeholders of the process, execution of the process steps, time horizon of the process in general and measurement and analysis of the process as a whole and the process steps independently.

7. Conclusion

The aim of this study was to identify how companies should design their Sales and Operations Planning process in order to address uncertainty in a make-to-order environment. Therefore, the following research question was formulated: *How should a Sales and Operations Planning (S&OP) process be designed in order to address uncertainty in a make-to-order environment?*

In order to answer this research question, qualitative research was done. Answering this research question was made possible by first performing a thorough literature review. Secondly, a case study was executed, during which interviews were conducted within a case company in a make-to-order environment. The results from the interviews show that, in order to address uncertainty in a make-to-order environment, companies should design a Sales and Operations Planning process according to the standardized steps as discussed in academic literature. However, the process can not be adopted easily, since the process needs to be reviewed first before implementation, so it will fit within company specific characteristics. Factors that should be reviewed in any case are the stakeholders of the process, execution of the process steps, time horizon of the process in general and measurement and analysis of the process as a whole and the process steps independently.

7.1 Contributions

Currently, a non-standardized Sales and Operations Planning is scarcely represented in academical literature. The majority of the research available on S&OP is only related to standardized processes. Besides, qualitative research and case study approaches present the minority of the research available on the topic. This study broadens the literature about research concerning S&OP by providing a real world situation, specifically looking at a business in a make-to-order environment. Additionally, the findings of this thesis provide researchers a new perspective on addressing uncertainty through Sales and Operations Planning in MTO environments. To illustrate, the findings argue that the design of a standardized process, as described by Ávila et al. (2019) is not easily adoptable to all organisations, since it is necessary to review the design in order to fit within company specific characteristics. Therefore, this study contributes to academical literature by providing additional knowledge on, not only Sales and Operations Planning as a process

in general, but also how Sales and Operations Planning should be adapted to better serve make-to-order environments.

Simultaneously, this research offers practical contributions in the sense that it provides managers and practitioners in the field with knowledge, insights and support regarding the design of a stepwise process of a thorough Sales and Operations Planning in a make-to-environment. By doing so, a S&OP process will enable companies to horizontal and vertical align functions and departments within the company, while also improving market and vertical volatility. As a result, uncertainty in a make-to-order environment can be addressed.

7.2 Limitations and Future Research

Although this research provides insights in designing a S&OP process in make-to-order environments, it does have its limitations. First, according to Sharma et al. (2020), Ivert et al. (2015) and Pedroso et al. (2016) literature and knowledge on Sales and Operations Planning processes is scarcely represented in academical literature. The available literature is mainly focused on Sales and Operations Planning in general and described standardized steps. So knowledge on customised S&OP process is lacking. However, this provides opportunities for future research, since there are some gaps regarding research on Sales and Operations Planning. One of these gaps is the missing literature on S&OP from different perspectives and environments, since Sales and Operations Planning processes within different and changing business environments are scarcely represented.

Second, according to Thomas (2015) and Creswell et al. (2007) generalisation from a case study is not possible, because contexts and cases differ. Besides, this study has been conducted as a unique single case study, focusing on a single company. Therefore, universal generalisation of the findings is not possible. Thus, this can be seen as a limitation of this research. Simultaneously, this provides opportunities for future research. This research used a case study as research methodology and is qualitative by nature. Future research could provide additional knowledge and literature on S&OP by executing quantitave research. By doing so, current qualitative knowledge, insights and pespectives can be complemented with quantitative data so a complete representation of Sales and Operations Planning can be given.

Third, there is a limitation regarding implementation and validation of the results, findings and design of the process. At the time of writing, results and findings from the interviews have not been implemented in the case company. This means that the customised design of the S&OP process including the expected advantages cannot be measured and thus validated. On the other hand, this provides opportunities for future research. When another research would be conducted after implementation of the results and findings, the design of the process for companies in a make-to-order environment can be validated. Additionally, within this future research, advantages of S&OP in a MTO environment can be measured, validating if the expected results are actually achieved. By doing so, the design of a Sales and Operations Planning process within a company in a MTO environment can be represented completely.

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References

Accenture. (2022). *Supply chain disruption*. Retrieved from accenture.com: https://www.accenture.com/us-en/insights/consulting/coronavirus-supply-chain-disruption

Adenso-Díaz, B., Moreno, P., Gutiérrez, E., & Lozano, S. (2012). An analysis of the main factors affecting bullwhip in reverse supply chains. *international Journal of Production Economics*, *135*(2), 917-928. doi:10.1016/j.ijpe.2011.11.007

Alturki, A., Gable, G. G., & Bandara, W. (2011). A Design Science Research Roadmap. 107-123. doi:10.1007/978-3-642-20633-7_8

Ancarani, A., Di Mauro, C., & D'Urso, D. (2013). A human experiment on inventory decisions under supply uncertainty. *International Journal of Production Economics*, *142*(1), 61-73. doi:10.1016/j.ijpe.2012.09.001

Andrade, C. (2018). Internal, External, and Ecological validity in Research Design, Conduct, and Evaluation. *Indian Journal of Psychological Medicine*, *40*(5), 498-499. doi:10.4103/IJPSYM.IJPSYM_334_18

Anisimova, T., & Mavondo, F. T. (2010). The performance implications of company-salesperson corporate brand misalignment. *European Journal of Marketing*, *44*(6), 771-795. doi:10.1108/03090561011032711

Ávila, P., Lima, D., Moreira, D., Pires, A., & Bastos, J. (2019). Design of a Sales and Operations Planning (S&OP) Process - case study. *Procedia CIRP*, *81*, 1382-1387. doi:10.1016/j.procir.2019.04.048

Baier, C., Hartmann, E., & Moser, R. (2008). Strategic alignment and purchasing efficacy: An exploratory analysis of their impact on financial performance. *Journal of Supply Chain management*, *44*(4), 36-52. doi:10.1111/j.1745-493X.2008.00071.x

Barlas, Y., & Gunduz, B. (2011). Demand forecasting and sharing strategies to reduce fuctuations and the bullwhip effect in supply chains. *Journal of the Operational Research Society*, *62*(3), 458-473. doi:10.1057/jors.2010.188

Bertrand, J. W., & Sridharan, V. (2001). A study of simple rules for subcontracting in make-to-order manufacturing. *European Journal of Operational Research*, *128*(3), 509-531. doi:10.1016/S0377-2217(99)00371-9

Bryman, A. (2012). *Social Research Methods* (Vol. 4). Oxford University Press.

Cecere, L. (2015). *What is the Value Proposition of Sales and Operations Planning?* Supply Chain Insights.

Cecere, L., Barrett, J., & Mooraj, H. (2009). Sales and Operations Planning: Transformation From Tradition. *AMR Research*, pp. 1-9.

Chaharsooghi, S. K., & Heydari, J. (2010). LT variance or LT mena reduciton in supply chain management: Which one has a higher impact on SC performance? *International Journal of Production Economics*, *124*(2), 475-481. doi:10.1016/j.ijpe.2009.12.010

Chang, W.-S., & Lin, Y.-T. (2019). The effect of lead-time on supply chain resilience performance. *Asia Pacific Management Review*, *24*(4), 298-309. doi:10.1016/j.apmrv.2018.10.004

Childerhouse, P., Disney, S. M., & Towill, D. R. (2008). On the impact of order volatility in the european automotive sector. *International Journal of Production Economics*, *114*(1), 2-13. doi:10.1016/j.ijpe.2007.09.008

Childerhouse, P., Hermiz, R., Mason-Jones, R., Popp, A., & Towill, D. R. (2003). Information flow in automotive supply chains - present industrial practice. *Industrial Management & Data Systems*, *103*(3), 137-149. doi:10.1108/02635570310465625

Christopher, M., & Holweg, M. (2017). Supply Chain 2.0 revisited: a framework for managing volatility-induced risk in the supply chain. *International Journal of Physical Distribution & Logistics Management*, *47*(1), 2-17. doi:10.1108/IJPDLM-09-2016-0245

Corsaro, D., & Snehota, I. (2011). Alignment and Misalignment in Business Relationships. *Industrial Marketing Management*, *40*(6), 1042-1054. doi:10.1016/j.indmarman.2011.06.038

Creswell, J. W., hanson, W. E., Plano Clark, V. L., & Morales, A. (2007). Qualitative Research Designs: Selection and Implementation. *The Counseling Psychologist*, *35*(2), 236-264. doi:10.1177/0011000006287390

Deloitte Insights. (2021). *Agility: The antidote to complexity*.

Denscombe, M. (2014). *the good research guide. For small-scale social research projects.* . McGraw Hill.

Dooley, K. J., Yan, T., Mohan, S., & Gopalakrishnan, M. (2009). Inventory management and the bullwhip effect during the 2007-2009 recession: evidence from the manufacturing sector. *Journal of Supply Chain Management*, *46*(1), 12-18. doi:10.1111/j.1745-493X.2009.03183.x

Dresch, A., Lacerda, D. P., & Antunes Jr, J. A. (2015). Design Science Research. 67-102. doi:10.1007/978-3-319-07374-3_4

Elbaum, S. (2004). *Dynamic sales and operations planning: the next generation solution to a dynamic marketplace.* Boston: Aberdeen Group.

Enchange. (2021). *Top 10 Benefits of Sales & Operational Planning (S&OP)*. Retrieved from supplychain.enchange.com: https://supplychain.enchange.com/top-10-benefits-of-sales-operational-planning-sop

Fitzner, K. (2007). Reliability and Validity: A Quick Review. *The Science of Diabetes Self-Management and Care*, *33*(5), 775-780. doi:10.1177/0145721707308172

Glas, A. H., Meyer, M. M., & Eßig, M. (2021). Covid-19 attacks the body of purchasing and supply management: A medical check of the immune system. *Journal of PUrchasing and Supply Management*, *27*(4). doi:10.1016/j.pursup.2021.100716

Gregor, S., & Hevner, A. R. (2013). Positioning and Presenting Design Science Research for Maximum Impact. *MIS Quarterly*, *37*(2), 337-355. doi:10.25300/MISQ/2013/37.2.01

Grimson, J. A., & Pyke, D. F. (2007). Sales and operations planning: an exploratory study and framework. *The International Journal of Logistics Management*, *18*(3), 322-346. doi:10.1108/09574090710835093

Gunasekaran, A., & Ngai, E. W. (2005). Build-to-order supply chain management: a literature review and framework for development. *Journal of Operations Management*, *23*(5), 423-451. doi:10.1016/j.jom.2004.10.005

Gupta, D., & Benjaafar, S. (2004). Make to order make-to-stock or delay product differentiation? A common framework for modeling and analysis. *IIE Transactions*, *36*(6), 529-546. doi:10.1080/07408170490438519

Hammersley, M., Gomm, R., & Foster, P. (2000). *Case Study Method.* London: Sage Publications Ltd.

Handfield, R. B., Straube, F., Pfohl, H.-C., & Wieland, A. (2013). *Trends and Strategies in Logistics and Supply Chain Management: Embracing Global Logistics Complexity to Drive Market Advantage.* Hamburg: DVV media Group.

Heizer, J., Render, B., & Munson, C. (2016). *Operations Management.* Pearson.

Hendricks, K. B., & Singhal, V. R. (2003). The effect of supply chain glitches on shareholder wealth. *Journal of Operations Management*, *21*(5), 501-522. doi:10.1016/j.jom.2003.02.003

Hill, T. (2000). *Operations Management, Strategic Context and Managerial Analysis.* London: MaxMillan Business.

Hinkel, J., Merkel, O., & Kwasniok, T. (2016). Good Sales and Operations Planning is No Longer Good Enough. *Supply Chain Management Review*.

Hirneisen, R. A. (2017). *Sales & Operations Planning: Creating a Formula for Success.* Daniel Penn Associates.

Ivert, L. K., Dukovska-Popovska, I., Fredriksson, A., Dreyer, H. C., & Kaipia, R. (2015). Contingency between S&OP design and planning environment. *International Journal of Physical Distribution & Logistics Management*, *45*(8), 747-773. doi:10.1108/IJPDLM-04-2014-0088

Joglekar, N., & Phadnis, S. (2020). Accelerating Supply Chain Scenario Planning. *MIT Sloan Management Review*, *62*(2), 72-76.

Johnson, P. F. (2019). *Purchasing and Supply Management.* McGraw-Hill Education.

Jonsson, P., Kaipia, R., & Barratt, M. (2021). Guest editorial: The future of S&OP: dynamic complexity, ecosystems and resilience. *International Journal of Physical Distribution & Logistics*, *51*(6), 553-565. doi:10.1108/IJPDLM-07-2021-452

Kahiluoto, H., Mäkinen, H., & Kaseva, J. (2020). Supplying resilience through assessing diversity of responses to disruption. *International Journal of Operations & Production Management*, *40*(3), 271-292. doi:10.1108/IJOPM-01-2019-0006

Kallio, H., Pietilä, A.-M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing*, *72*(12), 2954-2965. doi:10.1111/jan.13031

Ketchen, D. J., & Hult, G. (2007). Bridging organization theory and supply chain management: The case of best value supply chains. *Journal of Operations Management*, *25*(2), 573-580. doi:10.1016/j.jom.2006.05.010

Kingsman, B., Hendry, L., Mercer, A., & de Souza, A. (1996). Responding to customer enquiries in make-to-order companies: Problems and solutions. *International Journal of Production Economics*, *46-47*, 219-231. doi:10.1016/0925-5273(95)00199-9

Kolisch, R. (2001). *Make-to-Order Assembly Management.* Berlin: Springer.

Kreuter, T., Scavarda, L. F., Thomé, A. M., Hellingrath, B., & Seeling, M. X. (2021). Empirical and theoretical perspectives in sales and operations planning. *Review of Managerial Science*, *16*, 319-354. doi:10.1007/s11846-021-00455-y

Kristensen, J., & Jonsson, P. (2018). Context-based sales and operations planning (S&OP) research: A literature review and future agenda. *International Journal of Physical Distribution & Logistics Management*, *48*(1), 19-46. doi:10.1108/IJPDLM-11-2017-0352

Kruse, G. (2004). New win in old bottles? *Manufacturing Engineer*, *83*(3), 48-48. Retrieved from https://www.researchgate.net/publication/3348299_New_wine_in_old_bottles

Kumar, G. P. (2016). *Sales and Operations Planning (S&OP) - An Overview*.

Lapide, L. (2004). Sales and operations planning part I: the process. *The Journal of Business Forecasting*, *23*(3), 17-19.

Lapide, L. (2004). Sales and operations planning part 2: enabling technology. *23*(3), pp. 18-20.

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

Lee, H. L. (2004). The Triple-A Supply Chain. *Harvard Business Review*, *82*(10), 102-113. Retrieved from https://hbr.org/2004/10/the-triple-a-supply-chain

Lee, H. L. (2021). *The New AAA Supply Chain.* Management and Business Review.

Lee, H. L., Padmanabhan, V., & Whang, S. (1997). Information Distortion in a Supply Chain: The Bullwhip Effect. *Management Science*, *43*(4), 546-558. doi:10.1287/mnsc.43.4.546

Li, G., Yang, H., Sun, L., & Sohal, A. S. (2009). The impact of IT implementation on supply chain integration and performance. *International Journal of Production Economics*, *120*(1), 125-138. doi:10.1016/j.ijpe.2008.07.017

Li, H., & Womer, K. (2012). Optimizing the supply chain configuration for make-to-order manufacturing. *European Journal of Operational Research*, *221*(1), 118-128. doi:10.1016/j.ejor.2012.03.025

Linneberg, M. S., & Korsgaard, S. (2019). Coding qualitative data: a synthesis guiding the novice. *Qualitative Research Journal*, *19*(3), 259-270. doi:10.1108/QRJ-12-2018-0012

Maher, C., Hadfield, M., & de Eyto, A. (2018). Ensuring Rigor in Qualitative Data Analysis: A Design Research Approach to Coding Combining NVivo With Traditional Material Methods. *International Journal of Qualitative Methods*, *17*(1). doi:10.1177/1609406918786

Matthyssens, P., & Vandenbempt, K. (2008). Moving from basic offerings to value-added solutions: Strategies, barriers and alignment. *Industrial Marketing Management*, *37*(3), 316-328. doi:10.1016/j.indmarman.2007.07.008

Mohr, G., & Holtrup, M. (2019). Processes and Systems in Purchasing.

Murfield, M. L., Ellram, L. M., & Guinipero, L. C. (2021). Moving purchasing & supply management beyond a cos-focused identity. *Journal of Purchasing and Supply Management*, *27*(3). doi:10.1016/j.pursup.2021.100687

Nemati, Y., Madhoshi, M., & Ghadikolaei, A. S. (2017). The effect of Sales and Operations Planning on supply chains's total performance: a case study in an Iranian dairy compnay. *Computers & Chemical Engineering*, *104*, 323-338. doi:10.1016/j.compchemeng.2017.05.002

Nitsche, B., & Durach, C. F. (2018). Much discussed, little conceptualized: supply chain volatility. *International Journal of Physical Distribution & Logistics Management*, *48*(8), 866-886. doi:10.1108/IJPDLM-02-2017-0078

Nitsche, B., & Straube, F. (2020). Efficiently managing supply chain volatility: a management framework for the manufacturing industry. *Procedia Manufacturing*, *43*, 320-327. doi:10.1016/j.promfg.2020.02.166

Noroozi, S., & Wikner, J. (2017). Sales and operations planning in the process industry: A literature review. *International Journal of Production Economics*, *188*, 139-155. doi:10.1016/j.ijpe.2017.03.006

Olhager, J. (2003). Strategic positioning of the order penetration point. *International Journal of Production Economics*, *85*(3), 319-329. doi:10.1016/S0925-5273(03)00119-1

Olhager, J. (2010). The role of the customer order decoupling point in production and supply chain management. *Computers in Industry*, *61*(9), 863-868. doi:10.1016/j.compind.2010.07.011

Patrucco, A. S., & Kähkönen, A.-K. (2021). Agility, adaptability, and alignment: new capabilities for PSM in a post-pandemic world. *Journal of Purchasing and Supply Management*, *27*(4). doi:10.1016/j.pursup.2021.100719

Pedroso, C. B., da Silva, A. L., & Tate, W. L. (2016). Sales and Operations Planning (S&OP): Insights from a multi-case study of Brazilian Organizations. *International Journal of Production Economics*, *182*, 213-229. doi:10.1016/j.ijpe.2016.08.035

Peffers, K., Tuunanen, T., & Niehaves, B. (2018). Design science research genres: introduction to the special issue on exemplars and criteria for applicable design science research. *European Journal on Information Systems*, *27*(2), 129-139. doi:10.1080/0960085X.2018.1458066

Pereira, D. F., Oliveira, J. F., & Carravilla, M. A. (2020). Tactical sales and operations planning: a holistic framework and a literature review of a decision-making model. *International Journal of Production Economics*, *228*. doi:10.1016/j.ijpe.2020.107695

Prokopets, L. (2012). *S&OP: What you can learn from the top performers.* Supply Chain Management Review.

Qu, S., & Dumay, J. (2011). The qualitative research interview. *Qualitative Research in Accounting & Management*, *8*(3), 238-264. doi:doi.org/10.1108/11766091111162070

Robson, C., & McCartan, K. (2016). *Real World Research.* Wiley.

Saniuk, A., & Waszkowski, R. (2016). Make-to-order manufacturing - new approach to management of manufacturing processes. *IOP Conference Series: Materials Science and Engineering*. doi:10.1088/1757-899X/145/2/022005

Scavarda, L. F., Hellingrath, B., Kreuter, T., Thomé, A. M., Seeling, M. X., Fisher, J.-H., & Mello, R. (2017). A case method for Sales and Operations Planning: a learning experience from Germany. *Production*. doi:10.1590/0103-6513.219916

Schau, H. J., Muñiz, A. M., & Arnould, E. J. (2009). How Brand community Practices Create Value. *Journal of Marketing*, *73*(5), 30-51. doi:10.1509/jmkg.73.5.30

Scholten, K., & Schilder, S. (2015). The role of collaborations in supply chain resilience. *Supply Chain Management*, *20*(4), 471-484. doi:10.1108/SCM-11-2014-0386

Sein, M. K., Henfridsson, O., Purao, S., Rossi, M., & Lindgren, R. (2011). Action Design Research. *MIS Quarterly*, *35*(1), 37-56. doi:10.2307/23043488

Sharma, A., Adhikary, A., & BIkash Borah, S. (2020). Covid-19´s impact on supply chain decisions: Strategic insights from NASDAQ 100 firms using Twitter data. *Journal of Business Research*, *117*, 443-449. doi:10.1016/j.jbusres.2020.05.035

Sharman, G. (1984). The rediscovery of logistics. *Harvard Business Review*, *52*(5), 71-79. Retrieved from https://www.researchgate.net/publication/285372742_The_rediscovery_of_logistics

Shedlawski, J. (2017). *APICS S&OP Performance: Advancing Sales and Operations Planning*. APICS Insights and Innovations.

Simons, H. (2009). *Caes Study Research in Practice*. London: Sage Publications Ltd.

Skålén, P., Pace, S., & Cova, B. (2015). Firm-brand community value co-creation as alignment of practices. *European Journal of Marketing*, *49*(3/4), 596-620. doi:10.1108/EJM-08-2013-0409

Soman, C. A., van Donk, D. P., & Gaalman, G. J. (2004). Combined make-to-order and make-to-stock in a food production system. *International Journal of Production Economics*, *90*(2), 223-235. Retrieved from https://research.rug.nl/en/publications/combined-make-to-order-and-make-to-stock-in-a-food-production-sys

Stake, R. E. (1995). *The art of Case Study Research*. Thousand Oaks, CA: Sage Publications Ltd.

Stavrulaki, E., & Davis, M. (2010). Aligning products with supply chain processes and strategy. *Internaitonal Journal of Logistics Management*, *21*(1), 127-151. doi:10.1108/09574091011042214

Stentoft, J., Rajkumar, C., Freytag, P., & Mikkelsen, O. (2020). Sales and operations planning: emirical insights into perceived relevance and lack of implementation. *Supply Chain Forum: An International Journal*, 1-14. doi:10.1080/16258312.2020.1801106

Stevenson, M., Hendry, L. C., & Kingsman, B. G. (2005). A review of production planning and control: the applicability of key concepts to the make-to-order industry. *International Journal of Production Research*, *43*(5), 869-898. doi:10.1080/0020754042000298520

Taylor, D. H., & Fearne, A. (2009). Demand management in fresh food vlaue chains: A framework for analysis and improvement. *Supply Chain Management*, *14*(5), 379-392. doi:10.1108/13598540910980297

Templier, M., & Paré, G. (2015). A Framework for Guiding and Evaluating Literature Reviews. *Communications of the Association for Information Systems*, *37*. doi:10.17705/1CAIS.03706

Thomas, G. (2015). *How to Do Your Case Study*. London: Sage Publications Ltd.

Thomé, A. M., Scavarda, L. F., Fernandez, N. S., & Scavarda, A. J. (2012). Sales and operations planning and the firm performance. *International Journal of Productivity and Performance*, *64*(4), 359-381. doi:10.1108/17410401211212643

Thomé, A. M., Scavarda, L. F., Fernandez, N. S., & Scavarda, A. J. (2012). Sales and operations planning: A research synthesis. *International Journal of Production Economics*, *138*(1), 1-13. doi:10.1016/j.ijpe.2011.11.027

Thorbecke, W. (2008). The effect of exchange rate volatility on framentation in East Asia: Evidence from the electronics industry. *Journal of the Japanese and International Economies*, *22*(4), 535-544. doi:10.1016/j.jjie.2008.09.003

Tuomikangas, N., & Kaipia, R. (2014). A coordination framework for sales and operations planning (S&OP): Synthesis from the literature. *International Journal of Production Economics*, *154*, 243-262. doi:10.1016/j.ijpe.2014.04.026

Turner, C. (2018). Forget the Future of S&OP, What's the Future of Growth? *The Journal of Business Forecasting*, *37*(1), 11-16.

van Aken, J. E. (2004). Management Research Based on the Paradigm of the Design Sciences: The Quest for Field-Tested and Grounded Technological Rules. *Journal of Management Studies*, *41*(2), 219-246. doi:10.1111/j.1467-6486.2004.00430.x

van Weele, A. J. (2010). *Purchasing and Supply Chain Management.* London: Cengage.

van Weele, A. J. (2018). *Purchasing and Supply Chain Management.* Cengage.

Vidyarthi, N., Elhedhli, S., & Jewkes, E. (2009). Response time reduction in make-to-order and assemble-to-order supply chain design. *IIE Transactions*, *41*(5), 448-466. doi:10.1080/07408170802382741

Voortman Steel Group. (2022). *Over Voortman*. Retrieved from voortmansteelgroup.com: https://www.voortmansteelgroup.com/over-voortman

Wagner, S. M., & Bode, C. (2006). An empirical investigatino into supply chain vulnerability. *Journal of Purchasing and Supply Management*, *12*(6), 301-312. doi:10.1016/j.pursup.2007.01.004

Weiss, R. S. (1995). *Learning From Strangers: The Art and Method of Qualitative Interview Studies.* New York, USA: Simon & Schuster.

Whitten, D. G., Green, K. W., & Zelbst, P. J. (2012). Triple-A supply chain performance. *International Journal of Operations & Production Management*, *32*(1), 28-48. doi:10.1108/01443571211195727

Wieland, A., Handfield, R. B., & Durach, C. F. (2016). Mapping the Landscape of Future Research Themes in Supply Chain Management. *Journal of Business Logistics*, *37*(3), 205-212. doi:10.1111/jbl.12131

Wilson, E., & Raman, S. (2017). Why is the S&OP Process Stuck in Third Gear? *The Journal of Business Forecasting*, *36*(3), 10-14.

Wouters, M. J. (1991). Economic evaluation of leadtime reduction. *International Journal of Production Economics*, *22*(2), 111-120. doi:10.1016/0925-5273(91)90003-C

Wu, F., Yeniyurt, S., Kim, D., & Cavusgil, S. T. (2006). The impact of information technology on supply chain capabilities and firm performance: A resource-based view. *Industrial Marketing Management*, *35*(4), 493-504. doi:10.1016/j.indmarman.2005.05.003

Xiao, Y., & Watson, M. (2019). Guidance on Conducting a Systematic Literature Review. *Journal of Planning, Education and Research, 39*(1), 93-112. doi:10.1177/0739456X17723971

Ye, F., & Wang, Z. (2013). Effects of information technoogy alignment and information sharing on supply chain operational performance. *Computers & Industrial Engineering, 65*(3), 370-377. doi:10.1016/j.cie.2013.03.012

Zsidisin, G. A., Ellram, L. M., & Ogden, J. A. (2003). The relationship between purchasing and supply management's perceived value and participation in strategic supplier cost management activities. *Journal of Business Logistics, 24*(2), 129-154. doi:10.1002/j.2158-1592.2003.tb00049.x

Appendices

Appendix A: Interview protocol

1. Opening the interview

   Thank you for the willingness to participate in the interview and thus research. During our interview, I will be asking you about your opinion regarding Sales and Operations Planning and forecasting in a make-to-order environment. Your responses will be used as data within this research and will be processed anonymously. Before we begin the interview, do you have questions? [discuss questions] If any questions arise at any point, feel free to ask them at any time.

2. Explain the goal of the interview and research

   As I have mentioned to you before, my research seeks to identify how a S&OP process should be designed in order to address uncertainty in a make-to-order environment.

3. Introductory questions

   First, the introductory questions will be asked.

   - How is the current process regarding forecasting designed?
   - How would you describe the misalignment between demand and supply in the company?
   - What could be done to reduce the misalignment between demand and supply?

4. Key questions will be asked.

   - Are you familiar with forecasting and Sales and Operations Planning? If yes, how often do you work on/with the forecast and or S&OP process?
   - What are, from your perspective, the main (dis)advantages regarding forecasting and Sales and Operations Planning and how does this relate to the MTO environment?
   - How should the ideal S&OP process in a MTO environment be designed from your perspective?

5. Additional space for extra comments and feedback

   Give the interviewee space to give additional comments, feedback and opportunity to ask questions on the topic.

6. Closing the interview

Thank you again for your time and effort. I will provide you with a copy of the notes of the interview and will keep you updated on the way the results have been used in the research including the outcome of the research.

Appendix B: Interview guide for the semi-structured interviews

Deel 1 – MTO-context

1. Hoe ziet het huidige proces omtrent forecasting eruit?
2. Hoe zou je de onzekerheid/variabiliteit vanuit klanten (demand) beschrijven?
3. Hoe zou je de onzekerheid/variabiliteit vanuit leveranciers (supply) beschrijven?
4. Hoe zou je de verkeerde afstemming (misalignment) tussen vraag en aanbod (supply-demand) in het bedrijf beschrijven?
5. Wat zijn, volgens jou, de voornaamste oorzaken van deze verkeerde afstemming?
6. Wat kan gedaan worden om deze verkeerde afstemming te verminderen?
7. Ben je bekend met forecasting en S&OP? Indien ja, hoe vaak werk je mee/aan het forecasten en/of het S&OP proces? Wanneer? Waarom? Hoe?

Indien nee, Sales and Operations Planning is een middel om mee te forecasten en kan gezien worden belangrijk bedrijfsproces voor het ontwikkelen van een multifunctioneel tactisch plan dat alle bedrijfsplannen samenvoegt in één plan om zo concurrentievoordeel te behalen en het management de mogelijkheid te bieden het bedrijf strategisch te sturen. Met name in een make-to-order omgeving met levertijden die soms langer zijn dan een jaar kan het erg handig zijn om een S&OP proces op te zetten. Een standaard S&OP proces bevat de volgende stappen:

- Ontwikkel een ongelimiteerd verkoopplan (demand)
- Ontwikkel een initieel supply plan
- Ontwikkel een uiteindelijk operationeel plan
- Communiceer en implementeer het operationele plan
- Meet de prestaties van het proces

Deel 2 – het aanpassen van het S&OP proces

8. Wat zijn de grootste uitdagingen voor S&OP in een make-to-order omgeving?
9. Hoe zou een gestandaardiseerd S&OP proces aangepast moeten worden om beter aan te sluiten op de MTO omgeving?
10. Wat zouden de ideale stappen zijn van een S&OP proces om problemen m.b.t. de MTO omgeving aan te pakken?
11. Wat zijn, volgens jou, de grootste voor- en nadelen gezien forecasting en S&OP en hoe verhoudt zich dit tot de make-to-order omgeving?
12. Wie zou betrokken moeten zijn in het S&OP proces? Wie zou onderdeel moeten zijn van het S&OP team?

13. Welke tijdshorizon dient gehanteerd te worden om beter in te spelen op de MTO omgeving?
14. Op welk productniveau zou de planning en forecasting uitgevoerd moeten worden? (machine/module/artikel) waarom?
15. Wat is de ideale input vanuit Sales? Waarom?
16. Wat is de ideale input vanuit Operations? Waarom?
17. Wat is de ideale input vanuit Purchasing & Supply? Waarom?
18. Wat is de benodigde output van het proces en wie is hier verantwoordelijk voor?
19. Wat dient de regelmaat van het proces te zijn?
20. Wie is verantwoordelijk voor welke beslissing in welke stap tijdens het proces?
21. Wie is verantwoordelijk voor het proces? Wie is de proceseigenaar?
22. Hoe zou het meten en analyseren van het proces vormgegeven moeten worden?
23. Hoe vaak dient het proces gemeten en geanalyseerd te worden?
24. Hoe zou de informatie rondom de verschillende plannen en het uiteindelijke plan gecommuniceerd moeten worden en naar wie?
25. Heb je zelf nog ideeën die het proces kunnen verbeteren?