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Context-based Configuration of an Sales & Operations Planning Process

A Case Study of ASSA ABLOY Pedestrian Door Solutions

Master's thesis in Master's programme Production Engineering

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Abstract

Sales and Operations Planning (S&OP) is a business management process with the purpose to align operational plans with business goals and balance demand and supply capacity. By collaborative decisions taken during the S&OP process, all departments together develop and follow one integrated sets of plans in line with the business strategy. Increased complexity in supply chains and volatility in the market has contributed to increased recognition for the research field of S&OP. Though not new, the research field is yet partly unexplored.

Current literature on S&OP fails to explain how an S&OP process should be configured with respect to the context of where it's being applied. To close the gap, design science studies of S&OP design in different contexts are needed. ASSA ABLOY Pedestrian Door Solutions (ASSA ABLOY PDS), a global manufacturer, is experiencing difficulties with balancing demand and supply capacity and is considering an implementation of S&OP provided that entailed benefits motivate the cost of doing so. The circumstances made ASSA ABLOY PDS a suitable candidate for a case study of S&OP configuration. The purpose of the research was to increase the understanding of how an S&OP process should be configured in different contexts to enable effective demand & supply balancing, and what benefits such a process may entail. Hence, contribute to academia by providing insights to the contingency between the planning environment and S&OP configuration.

The research resulted in a summary of potential S&OP benefits associated with an effective S&OP process derived from current literature. In addition, a generalized proposition of a potential S&OP benefit was derived from the case study. Furthermore, four context-based process design propositions were derived from analysing 11 contextual variables and 7 contextual issues related to the demand and supply balancing process. Besides the contribution to academia, this thesis provided ASSA ABLOY PDS with a configured S&OP design concept that potentially could resolve experienced issues and entail benefits associated with an effective S&OP process.

Keywords: Sales and operations planning, S&OP, Supply chain management, S&OP benefits, S&OP configuration, Context-based S&OP configuration

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Introduction

1.1 Theoretical Background

Running a company is like orchestrating an orchestra (Ling and Goddard 1988). In the orchestra, everyone has to play to the same notes and pace to please to audience and for the music to sound good. Alignment between company strategy and operational plans, together with a balance between demand and supply, are essential to cutting stock and lead times, while increasing utilization and customer satisfaction (Wagner, Ullrich, and Transchel 2014).

Synchronizing the orchestra and making sure that all musicians know the notes, is the job for the maestro. Ling and Goddard (1988) liken Sales & Operations Planning (S&OP) with the company maestro: harmonizing sales, operations, marketing, logistic, engineering, sourcing and finance to operate to the company's notes i.e. the business strategy. S&OP is a business process used to align strategy and operational plans as well as to balance demand and supply (Wallace and Stahl 2008; Tuomikangas and Kaipia 2014; Wagner, Ullrich, and Transchel 2014). The potential benefits in literature are numerous, for instance increased forecast accuracy (Wagner, Ullrich, and Transchel 2014; Bower 2006), reduced inventory (Bower 2006; Wagner, Ullrich, and Transchel 2014), better customer service (Jonsson and Lindau 2019; Wagner, Ullrich, and Transchel 2014) and improved new product launch performance (Jonsson and Lindau 2019). The concept of S&OP is easy to grasp, however it is difficult to *successfully* implement with promised benefits (Wagner, Ullrich, and Transchel 2014).

Wallace and Stahl (2008) provide instructions on how to design and set up an S&OP process. Although some contextual factors are considered, such as production strategy (make-to-stock versus make-to-order), multiple site/sales units, global presence and type of MRP (Ptak and Smith 2018), the guides are generic but may still help with deciding on main activities. Other authors (Grimson and Pyke 2007; Danese, Molinaro, and Romano 2017; Wagner, Ullrich, and Transchel 2014) identified that many companies already practice S&OP to some extent. They developed maturity models in order to assess and develop companies' existing S&OP processes. However, nor these models consider the specific context of the company addressed, which is needed in order to achieve intended outcome (Kristensen and Jonsson 2018). The identified gap in S&OP literature is how the S&OP process should be fitted with respect to company context factors in order to savor the promised benefits. In

fact, current academia does not investigate performance of S&OP in different contexts and Kristensen and Jonsson (2018) propose design science studies to develop S&OP designs based on specific contexts as future research. Accordingly, this study addresses a case where the design of S&OP needs to be assessed and adapted in line with the requirements of it´s embracing context to realise more of the S&OP potential benefits. The case background is introduced in the next section.

1.2 Case Background

To address the research gap in literature, a case study was conducted at ASSA ABLOY Entrance Systems - Pedestrian Door Solutions (ASSA ABLOY PDS). The case company is a global manufacturer of automatic door opening solutions. ASSA ABLOY PDS has a several sales companies, called business units (BUs), spread worldwide. These are served by four production plants, also located in different parts of the world. ASSA ABLOY PDS' product portfolio consists mainly of three types of door solutions: "Swinger doors", "Slider doors" and "Revolving doors". ASSA ABLOY PDS also offers installation and service of its products.

ASSA ABLOY PDS is experiencing issues with the coordination of supply and demand planning, an issue that partly arises from the company's build-to-order policy, customer customization and a promise of short lead times. Today, ASSA ABLOY PDS does not have any formal process to efficiently balance demand and supply. This leads to both communication difficulties and miss alignment of demand and supply between the BUs and the supply chain department. The BUs are responsible for producing forecasts, more specifically each BU produce its own forecasts, one financial forecast for budget and one volume forecast of projected demand in units for the supply chain department. The quality and effort put into the forecasts vary depending on the BU. The volume plans are then consolidated by the supply chain department into one global volume plan. The accuracy of aggregated forecasts on product family level is relatively high. While the accuracy of the forecasts on the product is considerably lower showing large deviations between forecast and actual demand. The executive management mainly use the financial forecasts as support for decisions which is problematic since the financial forecasts and the volume plan are developed separately and therefore not always aligned. Due to product mix, this causes issues for operations, which is not always detected at the executive level.

There are also issues regarding production planning since BUs does not share upcoming orders in advance and orders are released intermittently. Another issue is the inability to share information about large upcoming orders, where BUs does not often consider the constraints of the operations organisation. Important to point out is that the markets that ASSA ABLOY PDS acts on mainly adopt tendering for procurement, and winning large-project contracts is, thus, a probability. Hence, the market is difficult to interpret and predict.

ASSA ABLOY PDS has connected these circumstances with pain points such as large inventory levels, wrong mix of inventory, extended lead times due to fluctua-

tions in released orders and unnecessary costs due to express freights and overtime. The issues presented have one thing in common, they are amplified by the lack of collaboration between the different departments involved, e.g. BU, supply chain and finance. Arguably, a well functional S&OP process have potentials to at least partly resolve the issues described above given that S&OP focuses on cross-functional integration and abandoning silo thinking.

1.3 Problem Definition

ASSA ABLOY PDS experiences issues which arguably could be resolved by an effective S&OP process design developed and configured with respect to its objectives and contextual factors. The challenge of adapting an S&OP process is to configure it in such a way that its potential benefits are unlocked. This is an issue described by several authors in S&OP literature (Wagner, Ullrich, and Transchel 2014; Kristensen and Jonsson 2018). However, actual research on the subject is scarce and Kristensen and Jonsson (2018) suggests further research. Consideration of contextual factors is, as mentioned, essential and consequently the identification of contextual factors. Hence, a case study is suitable since it allows the researchers to get a deeper understanding of the contextual factors of the company.

1.4 Aim

This study aims to increase the understanding of how an S&OP process design can be configured in order to enable an effective demand & supply balancing. Therefore, this study addresses how to configure an generic S&OP process for ASSA ABLOY PDS in such way that benefits associated with an effective S&OP process can be gained. More specifically, investigate how the S&OP process should resolve, or at least, partly resolve experienced issues related to supply and demand balancing at ASSA ABLOY PDS. Configuration shall be made by considering the contextual variables of ASSA ABLOY PDS. That is, the contribution of this study is represented by identifying S&OP configurations that fulfill the requirements of the underlying context when balancing demand and supply. Another contribution is represented by mapping benefits associated with an effective S&OP process in relation to extant research.

1.5 Research Questions

Two research questions have been formulated to fulfill the aim of this study. These are as follows:

> RQ1: Which potential benefits can be associated with an effective S&OP process?
>
> RQ2: Which S&OP process configurations do help, through realising potential benefits, to deal with issues driven by contextual variables towards demand-supply balancing?

RQ1 is needed to pinpoint which benefits could be expected by ASSA ABLOY PDS when implementing an effective S&OP process. It also summarizes the benefits suggested in current literature which might be valuable for other companies as well as for other researchers. As for RQ2, the case at ASSA ABLOY PDS will support academia by providing insights into the contingency between the planning environment and S&OP design.

1.6 Delimitations

As mentioned before, ASSA ABLOY ASSA ABLOY PDS has a number of BUs and 4 manufacturing plants. To evaluate each BU and manufacturing plant would result in a too comprehensive study. Therefore, the evaluation of the current S&OP process is limited to the sales organisation within the geographical areas of Sweden and the organisation connected to the production site in Czech Republic. However, the recommendations should in general be applicable throughout the organisation and not be limited by geographical factors. We have also chosen to adopt one maturity framework, rather than considering multiple or creating our own. The study investigates the effect of contextual factors, and there are many consider. To narrow scope, we've chosen to only consider the major contextual factors and disregarded smaller less important factors. The choice of contextual factors was also influence by factors discussed in literature, e.g. the paper by Kristensen and Jonsson (2018).

2
Theoretical Framework

In this chapter the theoretical base for this study is presented. The definition and goal of S&OP are presented, followed by contextual variables and parameters to consider when configuring an S&OP process. A summary on the S&OP process according to different frameworks, as well as a maturity framework used for evaluation of existing S&OP processes are also presented. Finally, benefits associated with an effective S&OP process are captured from literature and summarized in table 2.3 and 2.4.

2.1 S&OP Definition and Goals

In the early days of S&OP, Ling and Goddard (1988) defined the S&OP process as the link between the company's business plan and its departments. Moreover, Bozutti and Esposto (2019) defines the S&OP process as a tactical planning process, led by top-management recurrent on a monthly basis with the goal to balance supply and demand between, production, finance, logistic, procurement and sales ensuring alignment with strategies and plans.

Grimson and Pyke (2007) agrees with the goal of balancing demand and supply. However, they suggest that the explicit goal of S&OP is profit optimization through the S&OP plan focusing on profitability. Jonsson and Mattsson (2009) suggest that the main goal of S&OP is alignment of business goals thus its includes profitability and profit optimization.

2.2 S&OP Contextual Variables

Wagner, Ullrich, and Transchel (2014) pointed out the difficulty in implementing an S&OP process which brings promised benefits. The difficulty lies in fitting a generic concept to a unique setting. Hence, understanding the contextual variables of a company is of great importance when implementing an S&OP process. Kristensen and Jonsson (2018) charted contextual variables used in S&OP literature and found the following: manufacturing strategy, industry type, uncertainty in demand, the number of market and production units, firm size, hierarchical planning framework and organisational characteristics.

(Kristensen and Jonsson 2018) found no studies that determined whether or not manufacturing strategy has an effect on S&OP design in literature, while (Wallace

and Stahl 2008) suggests that importance of statistical forecasting in the S&OP process is lower in make-to-order than in make-to-stock environments. As for the level of uncertainty in demand and supply, a high level of uncertainty may require integrated scenario analysis in the S&OP design (Kristensen and Jonsson 2018). A large number of market and production units generate difficulty in coordinating S&OP process across different units. Since the units provide either individual demand or supply, the S&OP process may need sub-processes (Kristensen and Jonsson 2018). Type of industry may affect the choice of planning parameters such as the planning object according to Kristensen and Jonsson (2018), described further in section 2.3. The value of S&OP could be greater for a large firm due to the greater need for cross-functional coordination and alignment then in smaller firms (Kristensen and Jonsson 2018). Since S&OP is a link between tactical, strategical and operational planning, the hierarchical planning framework is of interest to consider even though no studies on its effect on S&OP design are available (Kristensen and Jonsson 2018). Organisational characteristics such as culture, top management support and involvement, are proposed to have effect on S&OP performance and design (Kristensen and Jonsson 2018).

Bozarth et al. (2008) suggests the number of suppliers and geographical distance to supplier, the number of customers, heterogeneity among customers and shorter product life cycles, the number of products, the number of parts, manufacturing schedule instability and on-of-a-kind batch production as contextual variables that may increase demand- and supply-related uncertainty, sales volumes, and supply capacity.

2.3 S&OP planning parameters

Five main S&OP planning parameters were elicited from literature, these are planning horizon, planning frequency, planing objects, unit of capacity, and time fences.

Planning Horizon
The planning horizon refers to the time spans which companies should consider when creating their S&OP plans (Jonsson and Mattsson 2009). For S&OP, common planning horizons are between 6 to 18 months Grimson and Pyke (2007) or even up to 2 years (Jonsson and Mattsson 2009). The S&OP planning horizon varies across companies and industries due to context variables such as seasonality, production lead time , type of industry, and product (Grimson and Pyke 2007). Companies with long production lead times or high seasonality tend to have longer planning horizon compared to companies with short lead times or low seasonality. According to Jonsson and Mattsson (2009), the planning horizon should cover the time it takes for operations to redirect available capacity to market demand to fully exploit both resources within the company and market opportunities.

Planning Frequency
The most common planning frequency for an S&OP process is on monthly basis (Grimson and Pyke 2007; Wallace and Stahl 2008; Thomé et al. 2012a). However, the research shows that more companies strive to have a more frequent basis, weekly or in some cases even daily meetings (Grimson and Pyke 2007). The factor that influence the frequency is the time of contracting which in many cases is relatively long and will therefore make weekly and daily meetings redundant. Common among companies is to have regularly scheduled meetings each period but Grimson and Pyke (2007) claims that companies with advanced S&OP processes implement "event-driven" S&OP processes. Meetings are scheduled whenever needed to handle exceptional issues or events such as operational problems or competitor actions.

Planning Objects
The planning object of S&OP can be at SKU level (Lapide 2005) or at more aggregated level such as product group or family, which is more common and recommended (Jonsson and Mattsson 2009; Grimson and Pyke 2007; Ptak and Smith 2018; Wallace and Stahl 2008). However, the product families should be composed of groups with similar resource and demand requirements (Jonsson and Mattsson 2009). Ptak and Smith (2018) advocate the usage of differently composed product families in different departments in order to create product families with similar resource requirements from the specific department.

Units of Capacity
Jonsson and Mattsson (2009) define the unit of capacity parameter as the level of detail in which the operations department expresses available capacity, which they recommend to keep at low levels (e.g. machine hours or man hours per month or units or tons per month based on the contextual variables) like the case for the planning object.

Time Fences
Time fences represent the time in future that the production plan is attached to the following planning occasions and by how much, and when, changes can be allowed. The ability to change capacity in the future shall be expressed in simple agreeable terms depending on the flexibility of the production and the lead times for material (Jonsson and Mattsson 2009; Wallace and Stahl 2008). As an example, company X has decided to have a capacity change limit of 10 % first month, 20 % the second month, 30% the third month and no limitations what so ever after the fourth month (Jonsson and Mattsson 2009).

2.4 The S&OP Process

This section describes the generic S&OP process steps, see figure 2.1. The steps are demand planning, supply planning, consensus meeting and executive review. In addition, some non-generic steps connected to certain authors' S&OP models are described briefly. The process steps of each model are presented in table 2.1.

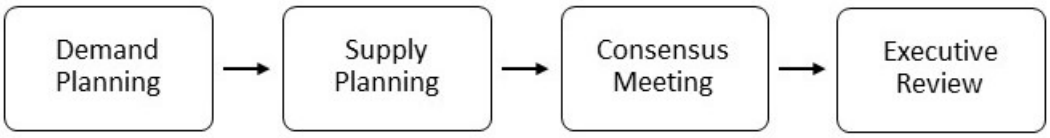

Figure 2.1: The generic SOP process.

2.4.1 Demand Planning

Demand planning is the first generic S&OP process step and aims to determine and evaluate the upcoming sales volume within the planning horizon. It's initialized by preparatory activities and pre-meetings in the sales and marketing departments with the purpose of gathering data, creating forecasts and providing discussion material to the demand review (Grimson and Pyke 2007; Ptak and Smith 2018).

Current month's actual sales, production, inventory levels, market trends and information on competitors are examples of information and data which need to be collected to determine future demand (Wallace and Stahl 2008; Ptak and Smith 2018). Communication with key customers facilitates determining the future demand, provided that a few customers make up a large part of business. It is also important to consult with the sales team and urge them to focus on upcoming trends of large customers and high-volume products (Wallace and Stahl 2008; Grimson and Pyke 2007).

With the data collected, a forecast can be made. An aggregated forecast at a product family level is generally suitable to facilitate the right level of focus in the S&OP process (Jonsson and Mattsson 2009). In special cases may forecasting on product level be needed (Ptak and Smith 2018). The initial forecast should not take sales goals, promotions nor fully utilized production facilities into account to provide an unconstrained forecast (Jonsson and Mattsson 2009; Grimson and Pyke 2007; Ptak and Smith 2018). The forecast should be generated in units first and then converted into money (Wallace and Stahl 2008). Forecasts made in money often lack the utility and focus required by the supply chain and operations departments. Conversion to money is nonetheless necessary for the economic perspective. In practice, forecasts are usually based on money and not units (Jonsson and Mattsson 2009).

The forecast is processed further and adjusted. Historic data is not always the most the appropriate predictor of the future. Examples of situational factors which make market knowledge-based forecasts more appropriate than history-based forecast are new products, new customers and economics dynamics. Hence, it is suggested to alter the initial statistical forecast where suitable, i.e. when indications of upcoming demand do not align with the statistical predictions (Wallace and Stahl 2008). Adjustments to forecast are made with respect to upcoming market plans, e.g. promotions or changes in product portfolio (Grimson and Pyke 2007). The outcome should reflect what the company intend to sell and deliver in this period. Other reasons for adjustments to the forecast could be that the forecasted volumes are higher

than what the sales budget permits, or the phase out of a certain product to make room for a new one (Jonsson and Mattsson 2009). Ptak and Smith (2018) stress considerations to proactive actions aimed to increase demand. In many cases, but not all, are a demand review held to summarize, formalize and agree on one demand plan (Wallace and Stahl 2008; Ptak and Smith 2018). Ptak and Smith (2018) states that a demand review is necessary in order to reach consensus among stakeholders. In the demand review should also issues encountered in the preparatory activities be addressed and preferably be resolved (Ptak and Smith 2018).

Through the entire demand planning process, assumptions need to be documented and attached to the demand plan to motivate the proposed volumes. Assumption tracking also increases the transparency and credibility the demand plan and establishes trust in the demand plan throughout the organisation. It also supports evaluation of the demand plan for learning and improvement purposes (Wallace and Stahl 2008; Ptak and Smith 2018). International companies should consider both local and global demand review (Ptak and Smith 2018).

2.4.2 Supply Planning

In the supply planning process, information of all relevant constraints within the supply chain and operations departments are collected and evaluated with respect to the demand plan. A supply review is held where this information is further evaluated and discussed. The output is a supply plan which includes production volumes, a financial evaluation, actions to overcome identified gaps between demand and supply capacity and possibly different evaluated scenarios (Grimson and Pyke 2007; Jonsson and Mattsson 2009; Wallace and Stahl 2008; Ptak and Smith 2018). The purpose is not to meet the demand plan, rather determining if it is possible to meet the demand plan with today's capacity. If demand exceeds supply capacity, actions to increase capacity should be proposed and cost of doing so (Ptak and Smith 2018; Wallace and Stahl 2008). Identifying and providing opportunities where sales can be increased due to overcapacity is crucial in order to increase utilization and increase profit (Ptak and Smith 2018).

The supply planning process should consider: the demand plan, supply constraints and opportunities for capacity increases and decreases, the overall business plan and product portfolio plan (Grimson and Pyke 2007; Jonsson and Mattsson 2009; Ptak and Smith 2018) A clear manufacturing/operations strategy containing goals of inventory levels, service levels, buffer levels and backlog levels, is essential in order to develop an optimal supply plan (Grimson and Pyke 2007). Furthermore, some manufacturing constraints are due to external factors such as the capacity of suppliers. Therefore, Ptak and Smith (2018) suggest a monthly collaboration with key suppliers. Involving key suppliers in the monthly S&OP process and establishing vendor managed inventory is important to manage changes in demand.

Suggested participants of the supply review are managers of supply chain, logistics, operations, materials, purchasing, quality, as well as master scheduler, representative from R&D and S&OP process owner. Similar to the demand review, local supply reviews may be carried out (Ptak and Smith 2018; Wallace and Stahl 2008).

2.4.3 Consensus Meeting

In the consensus meeting, representatives from both the demand and supply side formally meet and derive a proposed S&OP plan with the demand and supply plan as bases (Grimson and Pyke 2007; Jonsson and Mattsson 2009; Ptak and Smith 2018; Wallace and Stahl 2008). Grimson and Pyke (2007)) names the meeting attendees as the *S&OP* team and stresses the importance of that the whole organisation is represented in this team: sales, marketing, supply chain, operations and finance. Jonsson and Mattsson (2009) propose similar participants. Furthermore, Grimson and Pyke (2007) urge the need of an S&OP champion, preferably a senior executive, who is present in the formal meetings, reviews and approves the work.

Demand and supply capacity are mainly reviewed at an aggregated level, product groups or product subgroups, with focus on mismatch. Key performance indicators (KPI) such as sales performance, inventory levels and backlog could be reviewed as well (Wallace and Stahl 2008). This step also processes the financial plan and output of the new meeting activities (Ptak and Smith 2018). The aim of the consensus meeting is to derive an S&OP plan which balances demand and supply and which ensures that the company's strategies and goals are fulfilled, e.g. profit maximization or growth (Wallace and Stahl 2008). The meeting addresses unresolved issues from previous steps in the S&OP process, where either consensus haven't been found or where decision mandate was missing. Hence, serving as a filter towards the executive meeting in order to reduce executive management meeting time (Wallace and Stahl 2008; Jonsson and Mattsson 2009). It also facilitates and ensures that important decisions made within all business areas are aligned with the business plan and supports the budget (Ptak and Smith 2018).

The outcome of the meeting is a proposed S&OP plan with documented assumptions and recommendations for the executive meeting to come (Jonsson and Mattsson 2009; Wallace and Stahl 2008). An example of a recommendation could be: increase supply plan for product group x to meet demand plan. The consensus meeting also sets the agenda of the executive meeting (Wallace and Stahl 2008).

2.4.4 Executive Review

The final step of the S&OP process is an executive review. It is executive managements' task to approve or adjust the proposed S&OP plan in the meeting (Wallace and Stahl 2008). Adjustments are made mainly if S&OP plan does not correspond with business strategy. Unresolved issues and other agenda topics set by the consensus meeting are discussed (Ptak and Smith 2018; Wallace and Stahl 2008). This

meeting serves as an opportunity for executive management to review the performance of the business (Ptak and Smith 2018). The outcomes of the review may include adjustments and approvals related to the bottom-up developed S&OP plan (Wallace and Stahl 2008).

2.4.5 Non-generic Process Steps

The frameworks include a few process steps which are non-generic: *Product portfolio and new activities*, *Financial review* (Ptak and Smith 2018), *Distribute and implement* and *Measure* (Grimson and Pyke 2007).

The product portfolio and new activities review is a product management review combined with identification of on-going activities which may affect demand and supply. Process development and supply network re-configurations are examples of internal activities. External activities could be market development, promotions and merges and acquisitions. The purpose is to evaluate the effects and help the organisation to tackle them (Ptak and Smith 2018).

The purpose of Distribute and Implement & Measure is to distribute and implement the S&OP plan to key employees and finally measure performance and effectiveness of the S&OP process Grimson and Pyke (2007). Overall profitability should always be measured. Other suitable KPI may vary between different industries, e.g. capacity utilization, forecast accuracy and market share. Generally, the other frameworks integrates follow-up and distribution of the S&OP plan in other steps.

Ptak and Smith (2018) suggests a separate *financial review* which explicitly evaluates the financial impact caused by the proposed demand plan and supply plan.

Table 2.1: Summary of process steps of each S&OP process model.

	Demand planning	**Supply planning**	**Consensus meeting**	**Executive review**	**Non-generic steps**
Grimson and Pyke (2007)	1.Create unconstrained demand forecast	2.Create rough cut capacity plan	3.Create final operating plan		4.Distribute and implement 5.Measure
Wallace and Stahl (2008)	1.Data gathering 2.Demand planning phase	3.Supply planning phase	4.Pre-meeting	5.Executive meeting	
Jonsson and Mattsson (2009)	1.Forecast future demand 2.Prepare preliminary delivery plan	3.Prepare preliminary production plan	4.Adjust delivery and production plan	5.Settling delivery and production plan	
Ptak and Smith (2018)	2.Demand plan	3.Supply plan	5.Integrated reconciliation	6.Management review	1.Portfolio and new activities 4.Financial review

2.5 S&OP Maturity Models

There are several S&OP maturity models developed in literature and seven of them were recently mapped and compared by Danese, Molinaro, and Romano (2017). The general idea of the S&OP maturity models is to analyse companies' S&OP processes with respect to maturity stages established by the model. By doing so, a maturity index can be determined. All but one of the models charted by Danese, Molinaro, and Romano (2017) consider different dimensions, such as people, process and technology. The maturity model by Grimson and Pyke (2007) is considered a well known point of reference within the field of S&OP (Danese, Molinaro, and Romano 2017; Goh and Eldridge 2015) and have therefore been used to evaluate and visualize the maturity of the case S&OP-like process.

2.5.1 Grimson & Pyke's Maturity Model

The maturity model by Grimson and Pyke (2007) has five maturity stages in five dimensions including both business and information processes. To visualize the framework, they summarized it in a Maturity matrix, see table 2.2. Together with a

literature review, Grimson and Pyke (2007) conducted company interviews to bring industry insights to the model.

A stage 1 company has no S&OP initiative and practices, while stage 4 represents a company with advanced S&OP practices. Companies up to stage 4 where found in industry, but no stage 5 companies. A stage 5 company would be characterized with proactive S&OP practices and it is the ultimate S&OP practice that any company can achieve within a not to distant future. Since the Maturity matrix in table 2.2, can be a bit deceptive for a reader who is not familiar with the framework, the dimensions will be further presented in the following sections.

Table 2.2: Maturity matrix by Grimson and Pyke (2007).

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

Meetings and Collaboration

This dimension is one of the evaluated business processes and represents the human participation in S&OP. Starting at *stage 1* where the company totally lacks planning meetings between operations and sales departments. In fact, collaboration between the two department is rare and may only occur during crisis, e.g. serious quality issues or missed deliveries (Grimson and Pyke 2007). A silo culture prevails. It is also recognized by poorly produced forecasts by the sales department, which are barely, or not at all, used by operation.

In *stage 2*, questions related to S&OP are addressed in high level manager meetings. However, the focus lays within the financial part and not within actual integration of the two departments. The *third stage* entails executive S&OP meetings with focus on integration, as well as formal S&OP meetings between departments with associated pre-meetings within each department. Data from large suppliers and cus-

tomers may be used as input to these meetings. In *stage 4*, data from all suppliers and customers is frequently used. At this stage may customers, suppliers and other supply chain partners participate in the S&OP meetings. The *fifth stage* include the initiatives from stage 4. In addition, real time external and internal data are distributed to personnel and supply chain partners. The main difference is the introduction of event-driven meetings. By doing so, potential crises are avoided by quickly taking appropriate actions, instead of waiting for the next scheduled S&OP meeting (Grimson and Pyke 2007).

Organisation
Stage 1 of the organisation category simply implies no S&OP organisation and functions. *Stage 2* contains no formal S&OP functions, however some parts of the S&OP function are incorporated in other roles. In the *third stage*, the S&OP function is the responsibility of an existing position, for instance the supply chain manager or the product manager. A formal S&OP team could exist, but it's not a criteria. In *stage 4*, there must be a formally appointed S&OP team. To reach the stage must the team also have participation from executive management. In addition to reach the fifth and final stage, should the whole organisation recognizes the S&OP concept and the importance of its function (Grimson and Pyke 2007).

Measurements
The third dimension of the maturity model considers performance measurements of the S&OP process. Starting from the bottom, *stage 1* is associated with no ongoing measuring whatsoever beyond basic standard accounting systems. That implies no measuring of operations and sales. This entails difficulties in taking simple operations decisions (Grimson and Pyke 2007).

Follow-up measurements on how well operations manages to keep up with sales' demand plan is the criteria for classifying as a *stage 2* company. Climbing up to *stage 3* infer additional measuring of forecast accuracy. Without this measurement, the incitement to forecast accurately is non-existing. The *fourth stage* requires two additional areas of measurement: S&OP effectiveness and new product introduction. Lastly, measurements such as on-time delivery and forecast accuracy should be tracked over time, since a well functional S&OP process should improve these measurements. New product introduction should be measured using KPI:s such as number of successful introductions, time to market, development cost and ramp-up time (Grimson and Pyke 2007).

Stage 5 also includes profitability, which is common in industry. What is much less common, and what Grimson and Pyke (2007) suggests, is that each department reports profitability to the S&OP team and hold them partly liable for the results. The outcome is an organisation where the sales manager is not only responsible for the forecast accuracy, but also for lead time, inventory levels, etc.

Information Technology
The purpose of this dimension is to evaluate the company's information system and how information is stored and shared-throughout the company. The *first stage* of information technology is characterized by spreadsheets, belonging to individual managers. In stage 2 have the number of spreadsheets grown, but they are still individual. Some consolidation is carried out manually.

In *stage 3*, the information technology dimension is characterized by automatic centralization of information. There must also be a revenue or an operation planning software in use at the company to classify in the third stage. In comparison to stage 3, a *stage 4* company employ both a revenue and an operations planning software, linked to an ERP system. However, optimization in these software are made separately. An S&OP workbench should be implemented as well, which is a tool for sharing S&OP information among S&OP team members. Update of information are made batch-wise (Grimson and Pyke 2007).

Stage 5 is associated with real time data and full integration of S&OP-related software, enabling holistic profit optimization. On top of this, full integration with ERP system. The benefits are quick and profitable reactions to market change (Grimson and Pyke 2007).

S&OP Plan Integration
S&OP plan integration is determined by how well an organisation creates operations plans, sales plans, and integrates these. According to the case study by Grimson and Pyke (2007), S&OP plan integration is enabled by the dimensions meetings & collaboration, organisation and measurements. No clear evidence was found supporting information technology as an enabler for plan integration. However, advanced software could still reduce the effort of carrying out S&OP tasks by automatically and seamlessly gather and distribute S&OP related information.

Stage 1 is characterized by no S&OP and the operations department trying to fulfill orders without access to information on upcoming demand (Grimson and Pyke 2007). Moving on to *stage 2*, operations plan is fully driven by the sales plan. A one-way top-down communication where no operational capacities, utilization or variable costs are taken into account. Not until the *third stage* are some of operations' circumstances, e.g. capacity and utilization, taken into account when developing the sales and operations plan. Plans are now developed bottom-up and then adjusted to fit business goals. The sales plan is still the driver and plans are developed sequentially (Grimson and Pyke 2007).

The *forth stage*, is according to Grimson and Pyke (2007), characterized by collaborative and concurrent development of a highly integrated S&OP plan, where constraints in both supply and demand organisation are considered. For the *fifth and final stage*, the integration of sales and operations plan is seamless. The S&OP plan is developed to maximise overall company profitability, not the performance of single division.

2.6 Benefits of S&OP

Firstly, it should be pointed out that merely following a generic S&OP framework or maturity model does not induce promised effects. As already mentioned, it is essential that specific company contexts are considered when designing an S&OP process (Kristensen and Jonsson 2018). Likewise, could cross-functional alignment and its benefits occur without an S&OP process in place (Thomé et al. 2012b). Having that said, academia and practitioners promises potential benefits from an S&OP implementation, some promises are substantiated with statistical correlation and others derived from authors' experiences and opinions. The positive effects of S&OP found in the literature described below are summarized in tables 2.3 and 2.4. The benefits have also been connected to a specific generic process step, derived from literature.

Based on their survey, Jonsson and Lindau (2019) identified multiple benefits from S&OP, mainly within the areas of operational performance, alignment of organisation and strategy deployment. *Improved forecast accuracy* was one of the most significant effects experienced by companies with immature and mature S&OP processes. For S&OP advanced companies, strategic and integrative effects where the most significant outcomes from their S&OP processes. The most important effects from the survey are presented in tables 2.3 and 2.4. Interpreting the survey data of the study by Jonsson and Lindau (2019), one can conclude that S&OP advanced companies to a larger extent enjoy the benefits of S&OP.

In their literature review, Thomé et al. (2012b) charted studies which investigated the benefits of S&OP. Thomé et al. (2012b) focused on four studies where survey data had been collected in order to draw conclusions about S&OP effects based on statistics. These four studies investigate different elements of S&OP and therefore have different conclusions on performance effects of S&OP. For instance, one of the selected studies, by Hadaya and Cassivi (2007), looked into joint collaborative planning between supply chain partners and its effects. Some of the effects summarized in the paper by Thomé et al. (2012b) are enabled by certain components of the S&OP. These components are presented together with the benefits gained in tables 2.3 and 2.4. In the literature review by Thomé et al. (2012b), positive correlations are presented between operational performance, and formalised S&OP organisation and formal integration roles. However, informal organisational mechanisms had an even stronger positive correlation to operational performance, which indicates the importance of soft aspects when implementing S&OP.

Not all effects presented by Thomé et al. (2012b) are direct benefits associated with S&OP. Thomé et al. (2012b) included in their literature review the study by Hadaya and Cassivi (2007), where it's concluded that inter-organisational information systems (IOIS), e.g. information sharing in a vendor managed inventory system, increase flexibility in terms of responsiveness to market. Although S&OP activities *together* with supply chain partners does not correlate with increased flexibility, they boost relationships with partners and increase the usage of IOIS:s.

Wagner, Ullrich, and Transchel (2014) conducted a survey with 88 participating companies and additional interviews with operations and supply chain experts in order to understand the benefits of S&OP. They found benefits in terms of better use of inventory, increased customer service, and increased revenue. Wagner, Ullrich, and Transchel (2014) also conclude that S&OP can effectively align organisational plans if implemented and fitted correctly. Muzumdar and Fontanella (2006) has studied the report from *Aberdeen Group* where 200 companies was studied related to their S&OP performance. Muzumdar and Fontanella (2006) concludes from the report that S&OP practices has a substantial effect on improved customer service. He argues for that the effects is derived from a success full implementation of S&Op. According to Muzumdar and Fontanella (2006), there are five key components for a success full implementation, people, process, technology, strategy and performance where all of them have to be carefully considered.

Bower (2006) provides five value opportunities connected to S&OP and explanation to how they arise. Forecast accuracy is improved due to the effort put into collecting data, facts, assumptions and plan deviations for the demand review. Another contributing factor is the follow-up on forecast accuracy and continuous reflection on why the forecast deviated Bower (2006). Inventory levels are controlled in the supply review, where causes for variability are reviewed. Commonly, variability causes planners to safeguard by setting large safety buffers (Bower 2006). For instance, sales planners safeguard in order to keep service level high and provide short lead times to customers, while supply planners keep excess inventory due to distrust in forecast. Inventory levels can be reduced by unifying all business departments under one common S&OP plan. Full transparency of the S&OP plan is essential in order for the employees to find it trustworthy and important to avoid hedging behaviour (Bower 2006). Secondly, balancing supply and demand allows the company to stock the right inventory at the right time, reducing unnecessary inventory and express freights (Bower 2006). Reduction of obsolete inventory is generally achieved by the same measurements. Additionally, carefully managing phase in/out of products by portfolio management, an action included in the S&OP process framework by Ptak and Smith (2018), is effective to reduce obsolesce if deployed effectively (Bower 2006). Successfully highlighting information from portfolio management in the demand and supply planning processes facilitates better performance on product launched and more effective phase outs (Bower 2006). Through accurate demand planning and well-managed inventory can customer demand be met on time and thereby increasing service level. Better customer service is a competitive advantage (Bower 2006), thus a factor for increased revenue.

The benefits described can in some cases be hard to quantify and measured. In the article by Wallace (2010), benefits are divided into two categories: soft and hard. Hard benefits can be measured and quantified while the soft can´t. Thirteen companies with an effective S&OP process where studied by Wallace (2010). Among those thirteen, the hard benefit, *improved inventory levels* where quantified to an average decrements of 40 % in inventory value. However, Wallace (2010) concludes that

in some cases there were hard or even impossible to conclude if the improvement was caused by the S&OP process itself or a combination of processes such as lean production, six sigma and S&OP. Still, Wallace (2010) concludes that there where improvements regarding inventory levels in all studied companies regardless maturity of other initiatives outside S&OP. One of the soft benefits discussed is *more focused accountability and greater control*. Wallace (2010) argues that the benefit is derived from the top management ability to compare the performance of sales and operations with the forecast and production plan. Also by the clearness of process ownership, the sales department is held accountable for their forecast and the operations department are held accountable for their production plan. Sheldon (2006) suggests that an S&OP process gives improved accountability of large projects and new product implementation. By the engagement of the sales department and their documented assumptions, the S&OP process facilitates the visibility needed for top management to control the demand plan and thereby control product implementation and large projects.

Table 2.3: Hard benefits associated with S&OP found in literature.

S&OP hard benefits	**Source(s)**
Improved forecast accuracy	Jonsson and Lindau (2019) & Thomé et al. (2012b) & Wagner, Ullrich, and Transchel (2014) & Bower (2006)
Increased market share	Jonsson and Lindau (2019)
Improved performance of product launches	Jonsson and Lindau (2019)
More effective use of inventory (trade-off with service level and resources)	Jonsson and Lindau (2019)
Reduced inventory and obsolete inventory	Wagner, Ullrich, and Transchel (2014) & Bower (2006) & Wallace (2010) & Muzumdar and Fontanella (2006) & Nakano (2009)
Reduce number of express shipments	Wagner, Ullrich, and Transchel (2014) & Bower (2006)
Improved customer service in terms of service level, order fill rate and on time delivery	Bower (2006) & Wagner, Ullrich, and Transchel (2014) & Muzumdar and Fontanella (2006) & Nakano (2009) & Wallace (2010)
Improving capacity utilization	Jonsson and Lindau (2019) & Wagner, Ullrich, and Transchel (2014) & Sheldon (2006)
Operational performance increases with a formalised S&OP organisation and integration roles	Thomé et al. (2012b)

Mitigates negative effects on operational performance caused by uncertainty in markets	Olhager and Selldin (2007)
Increased return on assets	Wagner, Ullrich, and Transchel (2014)

Table 2.4: Soft benefits associated with S&OP found in literature.

S&OP soft benefits	**Source(s)**
Aligning the goals of the demand and supply functions	Jonsson and Lindau (2019)
Supporting focus on long-term strategy & growth plans for supply chain, sales and the overall business	Jonsson and Lindau (2019) & Sheldon (2006) & Wallace (2010)
Improved team work and coordination in supply chain	Jonsson and Lindau (2019)
Increasing proactive work in supply chain	Jonsson and Lindau (2019)
Communication and feedback between and within sales and supply chain departments facilitated	Sheldon (2006) & Wallace (2010) & Jonsson and Lindau (2019)
Hidden problems are detected earlier	Jonsson and Lindau (2019)
Increased supply chain visibility	Thomé et al. (2012b) & Wagner, Ullrich, and Transchel (2014)
Strengthened relationships with supply chain partners (mainly upstream) by conducting *S&OP activities together with them*	Hadaya and Cassivi (2007) & Nakano (2009)
Greater control through more focused process step accountability especially on large projects and new product implementation	Wallace (2010) & Sheldon (2006)

3
Methodology

In this chapter, the methodology applied in this study is presented and motivated. First, the choice of research design is presented followed by methods of data collection and analysis. Finally, the method of ensuring reliability and validity of the study is described.

3.1 Research Design

Current S&OP research does not investigate how an S&OP should be configured in different contexts to savour the promised benefits. To investigate specific contexts and get a deeper understanding of their influence on the S&OP configuration, a case study was chosen as research design. A case study allows to gain in-dept knowledge of the problem (Bryman and Bell 2011) and is particularly suitable when researching complicated phenomena in the environment in which they occur (Dresch, Lacerda, and Antunes 2015). The case study is also suitable as research design strategy when studying areas in which existing research and theory is incomplete. As this study aims to gain in-dept knowledge of context based S&OP design, an area which lacks research, the choice of research design is motivated. This study has been conducted, with some adaption, according to the case study activities described by Dresch, Lacerda, and Antunes (2015, p 22.). A schematic picture of the research workflow of this study is presented in figure 3.1.

3.2 Data Collection

The data collection was an important part of this this study since it was foundation of the rest of the work. It was therefore of importance that high quality data was collected. Primary data was collected through conducting interviews. Through a literature study and review of some, yet few, internal documents at ASSA ABLOY PDS was secondary data collected.

3.2.1 Primary Data

Common methods for gathering primary data are interviews, observations, surveys and workshops (Björklund and Paulsson 2012). Interviews provide the opportunity to gain knowledge of the studied area which is difficult to gain in other ways (Yin 2018). Since the study urged for in-depth knowledge of contextual variables and issues in order to answer RQ2, the primary data was collected trough interviews.

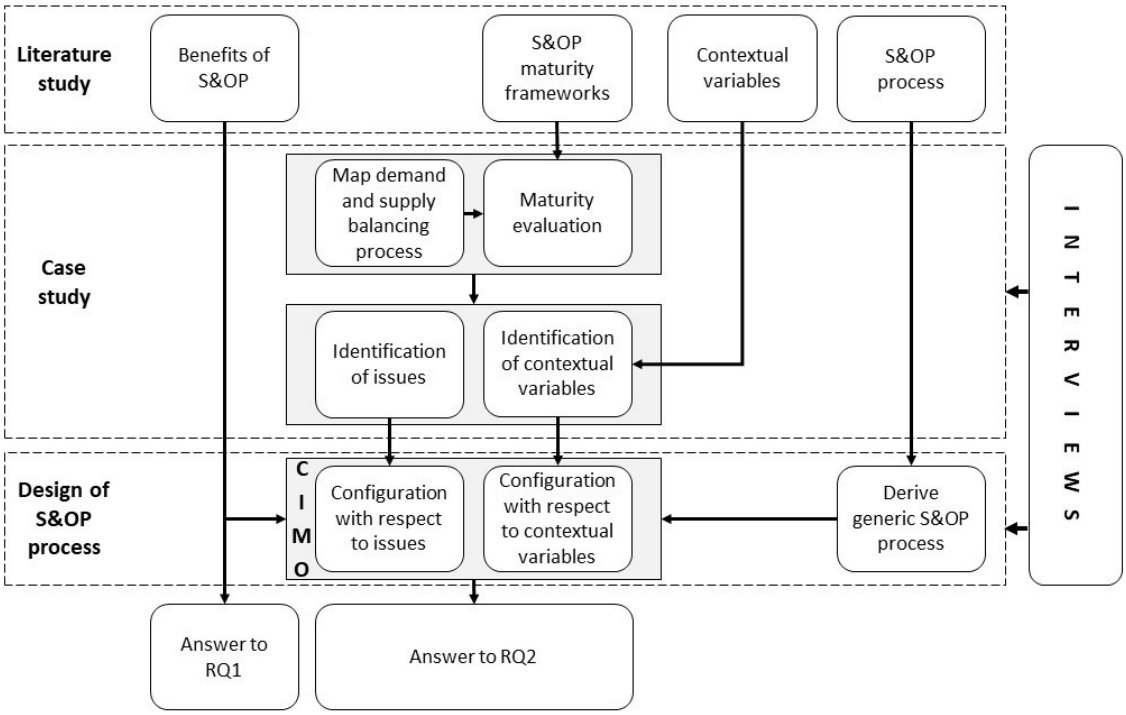

Figure 3.1: Research workflow.

A semi-structured interview is based on a set of interview questions, either open or closed, about moderately specific topics (Bryman and Bell 2011). It also allows for follow-up questions. This interview type is a combination of two other types: structured and unstructured interviews. The structured interview is characterized by set of closed questions with predetermined answers and the unstructured interview uses open-ended questions and provides full flexibility (Yin 2018). The unstructured interview allows change of questions based on the answers from the interviewee. For the initial round of interviews, the semi-structured interview type was applied to be able to utilize follow-up questions, yet have somewhat of a structure to facilitate reliability. After the initial interview round, unstructured follow-up interviews were held to fill potential knowledge gaps and discuss topics of special interest further.

Interviews

The goal of the interviews was to find the data required to map the current demand and supply balancing process, assess the maturity of the process, uncover issues related to the process, and identify contextual variables. To identify which stakeholders to interact with, an initial interview was held with the supply chain director, in which a rough map of the demand and supply balancing process and associated stakeholders created. Departments involved in the S&OP process according to S&OP literature, see section 2.4, were also considered to cover all departments potentially affected by an S&OP process implementation. An initial round of interviews was held with these identified stakeholders. By doing so, multiple perspectives were gained on the matter. All interviewees corresponding departments and the number of interviews are listed in table 3.1.

Table 3.1: Interviews held with employees at ASSA ABLOY PDS

Department	**Role**	**No. of interviews**	**Provided info**
R&D	R&D Manager	1	Products, product introduction
Marketing	Marketing & Communication manager	1	Marketing strategy
Supply Chain (operations)	Plant manager	2	Manufacturing, capacity planning
Supply Chain (operations)	Material Manager	2	Material handling, requirements planning
Supply Chain	Master Planner	1	Forecasting, process set-up, tools and methods
Supply Chain	Controller	1	Accounting, measurements
Supply Chain	Industrialization manager	1	Phase in/out
Executive Management	Director of Business Control	1	Business management, measurements
Executive Management	Commercial Director	2	Process, cross-functional communication, business strategy
Executive Management	Supply Chain Director	2	Process, issues, contextual variables
BU Sweden	BU Manager	3	Forecast, sales process, tools and methods.
BU Sweden	Sales Manager	2	Forecast, quotation process, tools and methods
Bu Sweden	Finance Manager	1	Data used, forecast
Entrance Systems Management	Material Director	8	S&OP experience, material handling, DDMRP

Since the interviews were of semi-structured character, both open and closed questions were defined prior to the interviews were conducted. Questions were specifically written for each interview, but there were also a set of general questions which were used in multiple interviews. A selection of the questions are available in appendix A.2. The interview questions were formulated based on S&OP literature, mainly influenced by the example list of questions for assessing the S&OP maturity provided by Grimson and Pyke (2007).

Presentation and feedback sessions
Finally, during the configuration of the S&OP process, presentations were held for stakeholders at ASSA ABLOY PDS to establish the proposed S&OP process among them and to receive feedback and refine the final S&OP process proposal. The agenda was simply a presentation of the process steps which affected the stakeholder followed by scheduled time for feedback.

3.2.2 Secondary Data

Secondary data refers to information already collected by someone else for another purpose than the current study. Examples of sources of secondary data are published material, books and papers, or internal documentation at a company (Björklund and Paulsson 2012).

Literature Study
A literature study on the area of S&OP was conducted to establish a theoretical basis for the upcoming study. The purpose was to synthesize the knowledge of the variables related to the S&OP process. For RQ1, we searched for benefits associated with an effective S&OP. For RQ2, the areas of interest were S&OP planning parameters, contextual variables, the generic S&OP process, S&OP configuration and S&OP maturity frameworks. Literature covered within the study were printed books, journal articles, e-books, and reports, such as white papers and internal documentations. The literature study was an ongoing process throughout the whole study since it was needed to go back to literature to find more information on contextual variables and S&OP configurations during the analysis.

Internal Documents from ASSA ABLOY PDS
Some secondary data from ASSA ABLOY PDS was collected in the form of internal work documents. Unfortunately, process description of the current demand and supply balancing process did not exist and generally there were few process descriptions available. The internal documents used were either related to business strategies or were forecasting spreadsheets.

3.3 Case Evaluation

The purpose of the case evaluation is to gain an understanding of the case by mapping and assessing the maturity of the current demand and supply balancing process, identifying the contextual variables of the company and the issues related to the current demand and supply balancing process. The outcome of the case evaluation is used for designing and configuring the S&OP process for ASSA ABLOY PDS.

Mapping the Demand and Supply Balancing Process
Given the gathered data from the interviews, the current the demand and supply balancing process at ASSA ABLOY PDS was mapped. To structure the process mapping, an excel-based template inspired by the SIPOC model was developed, see

appendix A.1. The SIPOC model breaks down sub-process to activities, inputs, outputs, participants and receiver of outputs (Theisens and Hampsink 2018). Based on the sub-processes, a swimlane diagram was created to visualize the whole demand and supply balancing process.

Maturity Evaluation
The charted demand and supply balancing process was compared to the criteria of the five categories of the maturity model by Grimson and Pyke (2007). Each maturity stage of the categories were evaluated and analysed to find the most suitable maturity stage. The maturity of the case process were determined and discussed with stakeholders to gain validity of the result.

Identification of Issues
This step of the analysis addressed issues associated with the current demand and supply balancing process. Issues were identified using the data from the interviews and questions regarding experienced issues were asked specifically in the interviews. Found issues were presented to other stakeholders to determine whether the issues were shared or if they only were personal opinions of certain interviewees. The maturity framework also helped to identify issues within the case company, since it shows what kind of processes are missing within the demand and supply balancing. The found issues were categorised as issues that potentially could be resolved by an effective S&OP process.

Identification of Contextual Variables
From data gathered at ASSA ABLOY PDS, contextual variables were derived. The choice of contextual variable was inspired by ones described in the papers by Kristensen and Jonsson (2018) and Bozarth et al. (2008), see section 2.2. Not all variables was used, but rather the ones applicable in this case.

3.4 Design of S&OP Process

These analysis steps describe how a generic S&OP process was derived and how it was configured to fit ASSA ABLOY PDS.

Deriving a Generic S&OP Process
In the literature study, several S&OP processes by different authors were reviewed. A generic S&OP process was derived based on common characteristics of the reviewed S&OP processes. The generic process does not contain any configurations. However, it was to this S&OP process configurations based on contextual variables and issues were made at a later stage of the study.

Configuring the S&OP Process
Kristensen and Jonsson (2018) propose design science studies to develop S&OP designs based on specific contexts as further studies. This suggests that the research area is rather novel. Hence, a standard method to derive the S&OP configurations from contextual variables is not available. Denyer, Tranfield, and Aken (2008) sug-

gest CIMO-logic for design science studies and states that design propositions in management literature are frequently based on IO-logic. Hence, context is ignored. Furthermore, it is suggested that CIMO-logic address this issue. Since this study has a focus on the influence of contextual variables, CIMO-logic is potentially a suitable method for deriving S&OP configurations. Furthermore, when deriving propositions the CIMO-logic gives the researcher the option to use available research. This provides the possibility to use available S&OP research to develop configurations.

Table 3.2: How the CIMO-logic, described by Denyer, Tranfield, and Aken (2008), was applied.

Component	**How it was defined**
Context	Defined as either contextual variables or issues related to the balancing of demand and supply
Outcome	Defined by the ambitions and targets of the company, or as resolved contextual issues
Intervention	An S&OP process configuration which would triggering the a specific mechanism
Mechanism	A behavior or function which would likely yield the desired outcome

The CIMO-logic is based on four components: context, interventions, mechanisms and outcome. *Context* refers to the surrounding factors in the organisation and *intervention* to the tools or methods the organisation have at their disposal to steer the business in the right direction. A *mechanism* is the response of an *intervention* and it is an act which executes the directions of the Intervention to gain a desired Outcome. The *outcome* is therefore the result of the *intervention* in different aspects, such as cost reduction, performance improvement or low error rates. How the CIMO-logic was applied in this study is described in table 3.2. By using the theoretical framework, found contextual variables and issues together with the CIMO-logic, suitable configurations to the generic S&OP process was developed.

3.5 Validity and Reliability

Reliability is defined as to what extent could we expect the same results if the study was repeated (Björklund and Paulsson 2012), e.g. how precise are our measurements. A common way of enhancing reliability is through triangulation, which is achieved by gathering and comparing the information on the same subject from different sources. Triangulation also enhances the validity of the study.

The first round of interviews were semi-structured, mainly with predefined open questions and follow-up questions. This opens up for some difficulty in receiving identical information from an interview person twice since another researcher might ask other follow-up questions. However, interviewing all S&OP affected departments and multiple stakeholders from each department implies information overlap,

i.e. triangulation. Due to this, it is likely that another researcher would gain a similar understanding of the case company as the authors did.

Validity is determined by whether or not the study measured what was intended to be measured (Björklund and Paulsson 2012). Bryman and Bell (2011) adds the dimension external validity, which refers to the generalizability of the results. Due to this case study having a specific context, the generalisation of results is rather low. However, some generalization is possible, which is further discussed in chapter 6 discussion. Validity is reached by controlling the variables affecting the results. To ensure validity of collected data, notes were taken during all interviews. Any uncertainties discovered when summarizing the notes were sent to the respective interviewee to sort it out. In some cases, follow-up interviews were conducted. Several stakeholders from each department affected by an S&OP process were identified and interviewed to ensure a satisfactory S&OP design, where all departments' perspectives and needs are considered. The empirical findings were also sent out to several of the interviewees for them to give feedback, make corrections and add missing information.

During the development of the S&OP design, sub-processes, e.g. the demand planning, were presented for stakeholders from key departments and they were able to provide feedback to ensure a satisfactory outcome. The S&OP design was also presented as a whole for the supervisors at ASSA ABLOY PDS at a late stage of the design process.

4
Empirical Findings

4.1 ASSA ABLOY Group

ASSA ABLOY Group is one of the global leaders in opening solutions. In 1994 occurred a merger between the Finnish company Abloy and the Swedish company ASSA. This was the start of what today is known as the NASDAQ-listed ASSA ABLOY Group. Within the group there are approximately 50 thousand employees in more than 70 countries. Growth permeates the organisation and is achieved by both organic growth and acquisition of other companies. The organisational structure of ASSA ABLOY can be seen in figure 4.1 and consists of five divisions: Entrance systems, EMEA, Americas, Global Technologies and Asia-Pacific. Entrance systems is the largest division with approximately 25 billion SEK in revenue 2018. Entrance Systems specializes in door automation solutions in different customer segments. Entrance Systems sales structure is divide into the "direct channel" and the "indirect-channel". Products sold within the direct channel are branded with ASSA ABLOY. The "indirect channel" consists of ASSA ABLOY-owned companies, which sell slightly modified ASSA ABLOY products with different branding. The "direct channel" consists of three different product segments, where Pedestrian Door Solutions is one.

4.2 S&OP context

In order to configure an S&OP process to fit ASSA ABLOY PDS, the case specific context needs to be identified. The context presented in this chapter is based on what is relevant for a future S&OP process and is derived from interviews conducted at ASSA ABLOY PDS. The selection criterias from which contextual variables to consider are derived from the theoretical framework 2.2. The context is supported by formal internal documents and process descriptions, even though few are available.

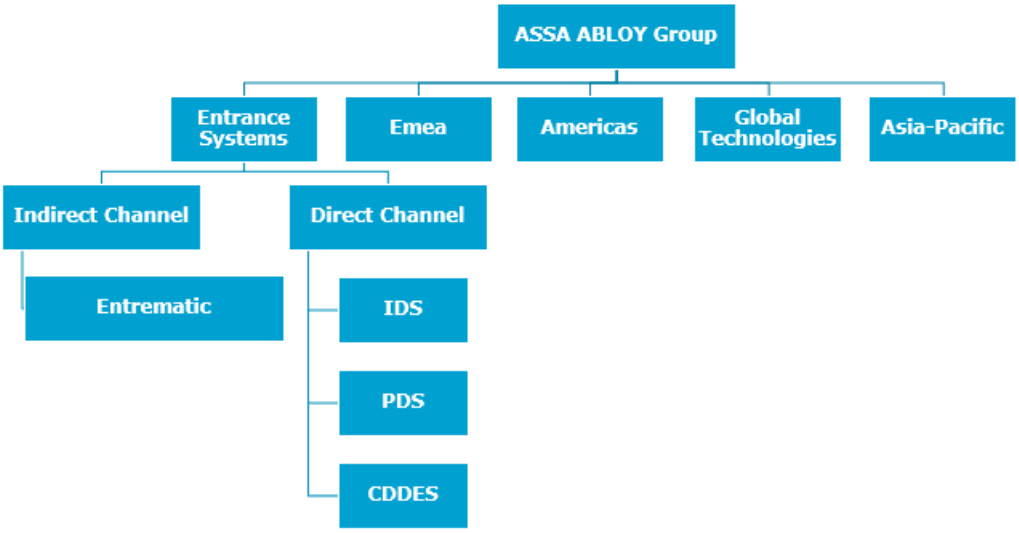

Figure 4.1: Organisation structure ASSA ABLOY group.

4.2.1 Business strategy

ASSA ABLOY PDS business strategy aims to expand the company and become market leader in automatic door solutions within selected regions and segments. The strategy is based on a number of core competences together with complementary tools to facilitate growth. To translate the overall strategy to operational level, the managers develop own strategies within their departments. The outcome of this is varying throughout the organisation. Employees in certain departments consider the strategy well established in the organisation, while other employees beg to differ. This strategy allows each manager to put their own print on the organisation.

4.2.2 Organisation

ASSA ABLOY Entrance systems and ASSA ABLOY PDS has during the recent years experienced a large growth, both through organic growth but also through the many acquisitions. In 2010 there were 2800 people employed by Entrance systems, in 2019 this number is over 11000. This has made the organisation bigger and more complex. The ASSA ABLOY PDS global organisation, located in Landskrona, Sweden, aims to align the many BUs and manufacturing facilities around the globe. The organisational structure is shown in figure 4.2 and the positions above the dotted line represent the executive management.

The entire sales organisation is divided into 31 BUs. The BU are divided onto three commercial directors, who represent them in the executive management. The majority of the BUs acts on national markets, while some on regional. Generally,

each BU consists of a sales, an installation and a service department. The sales department conducts the actual sales, the installation departments carries out the installation of sold products and the service department performs maintenance on sold products. Each BU also have a financial controller of their own. Moreover, ASSA ABLOY PDS has 4 production plants, one in Czech republic, China, USA and smaller plant in Canada. With some exceptions each plant meets regional demand. Beyond that, the Chinese factory partly supplies the Czech, American and Canadian factories.

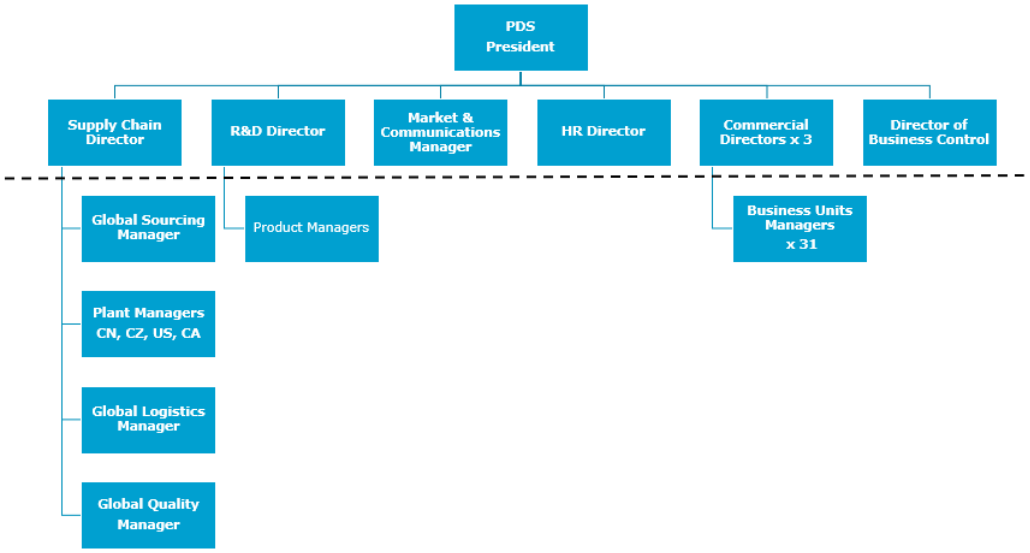

Figure 4.2: Organisation structure Pedestrian Door Solutions.

4.2.3 Products

ASSA ABLOY PDS manufactures, sells, installs and service automatic door opening applications for pedestrians. The product portfolio of ASSA ABLOY PDS, figure 4.3, mainly consists of three different automated door opening solutions, "Swinger operators", "Slider operators" and "Revolving doors". Since ASSA ABLOY PDS offers complete door solutions, they also manufacture the actual doors (Automated door systems). Two of the products are purchased from suppliers and the rest are produced by ASSA ABLOY PDS themselves. Each product comes in different variants. For instance can a certain swinger-model be configured to push the door open or pull the door open, depending on the customer needs. Components are modular to some extent, but modularity is still an area of potential improvement.

Figure 4.3: Product portfolio of ASSA ABLOY PDS.

Build-to-order

Sales in the indirect channel are standard products sold through Entrematic. However, the majority of sold products are to some extent build-to-order. Height, width, colour and various features are all customer specific with few stated limits.

Product phase in/phase out

Historically has ASSA ABLOY PDS been a product-oriented company. Products were developed by R&D and handed over to the BUs. The view on product development has changed over the years and current product development process is more sophisticated in the sense that other departments are involved. Usage of a gateway process to manage continued development ensures involvement from all departments. The result is a development process with more focus on market needs and producibility. The business is based on certification and it's important to create an even flow of the slow and expensive certification processes according to the The R&D manager. As a result, products are released in a relatively even flow.

ASSA ABLOY PDS are more than able to put new product on the market, but they lack the ability to effectively phase out product. Derived effects are increased number of SKU:s as well as increased complexity in supply chain, operations and forecasting. The reason is simple, some BUs argue there is still a demand for older products. If this is due to an actual market demand or due to promotion of the older products is unknown.

4.2.4 Customers

Typical end-customers of ASSA ABLOY PDS are shown in figure 4.4, where the public sector and healthcare were the largest in 2018. It's common that the products are sold in conjunction with an ongoing construction or remodeling. Contractors are often eager to require high delivery precision but not always accurate when planning installation date. Postponement of installation date are therefore not unusual and complicates the supply chain and operations even further.

ASSA ABLOY PDS often pursue larger projects, e.g. deliver door solutions to hospitals being built. It's great business since it brings in large volumes in few unique configurations. The downside is workload peaks and substantial changes to the current product and variant mix, making life hard for those employees planning material. In order to avoid surprises is the supply chain department often informed by BU about ongoing large quote processes. There is a standard procedure established on how large orders should be communicated and discussed across the organisation. However, the process is not always followed and large order quotes are informally communicated via email to the supply chain organisation, or to operations directly, or not communicated at all.

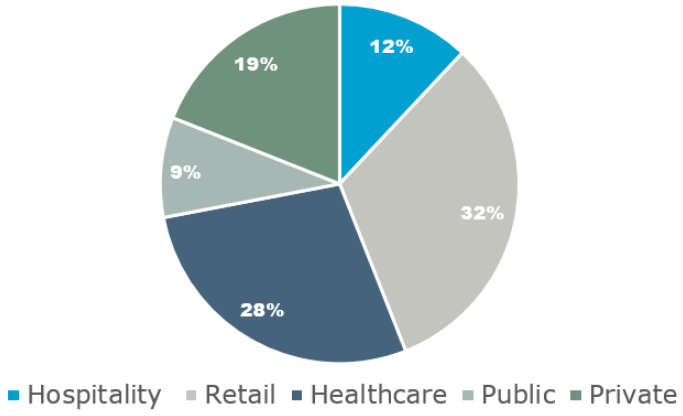

Figure 4.4: Line of business Pedestrian Door Solutions Equipment Sales 2018

4.2.5 Operations

ASSA ABLOY PDS has four manufacturing facilities around the globe, strategically placed in China, Czech Republic, USA and Canada. They all produce products to a certain geographical area. However, the products in different areas are in fact not always the same due to local preferences. Therefore, the variety and volume of products differs between the facilities. As mentioned in section 1.6, Delimitation, this thesis´ scope is limited to only investigate the Czech production plant.

There is no processing of raw material in the Czech production plant. Purchase aluminum extrusions are post processed with methods such as milling and cutting. In fact, the plant mainly perform order kitting and final assembly since most components are outsourced to external suppliers.

Aluminum extrusions are used in all products and arrive to the plant in various lengths and shapes. These are cut to the customer specific length and hole patterns are either punched or milled to match the specific specifications. Finally, they are manually assembled together with all components, specified by customer, in the order configuration. The finished product are then packaged and shipped, either direct to customer or to a BU warehouse.

4.2.6 Current S&OP-like processes

This section is a description of a set of processes which together provide the existing bridge of communication between market and operations, i.e. the function of S&OP. More specifically, the processes stretches from the initial development of the volume plan to the production plan and derived supplier plan. As we will see further on, all of these process aren't as connected as one might think.

The whole process has been mapped and divided into sub-processes, and each sub-process into a set of activities describing them in further detail. To gain a holistic view of the mapped processes a process map was developed, see figure 4.5. In line with the delimitation, only processes in BU Sweden and the Czech production site have been mapped.

BU financial forecast and budget
The yearly budget and financial forecasts are vital elements of ASSA ABLOY PDS business control. The meticulous monitoring of the BUs' performance is carried out by reviewing the yearly budget with three financial forecasts: FC1, FC2, and FC3. FC3 is made in the end of quarter three and shows the expected balance sheet of each BU for the last quarter of the current year and all four quarters for the year to come. This forms the basis for next year's budget. FC1 is made in the end of quarter one and extends to the end of the year, i.e three quarters ahead. Lastly, FC2 is made in the end of the second quarter and is also extended to the end of the year.

At the Swedish BU, development of the budget and forecasts are comprehensive tasks that involve all departments of the BU. To start of, the middle managers: Sales, Installation and Service, in the BU gather data and have forecast meetings with involved employees in each department. Market shares, assumptions regrading the market, order trends, customers markets and similar are input used to evaluate the future demand. The forecast is made on product group level: Swingers, Revolvers and Sliders. Then the managers have meetings together to consolidate the BU's total forecast and discuss data and assumptions. After the consolidation of forecasts, a review of the current prices is done. Global goals from executive man-

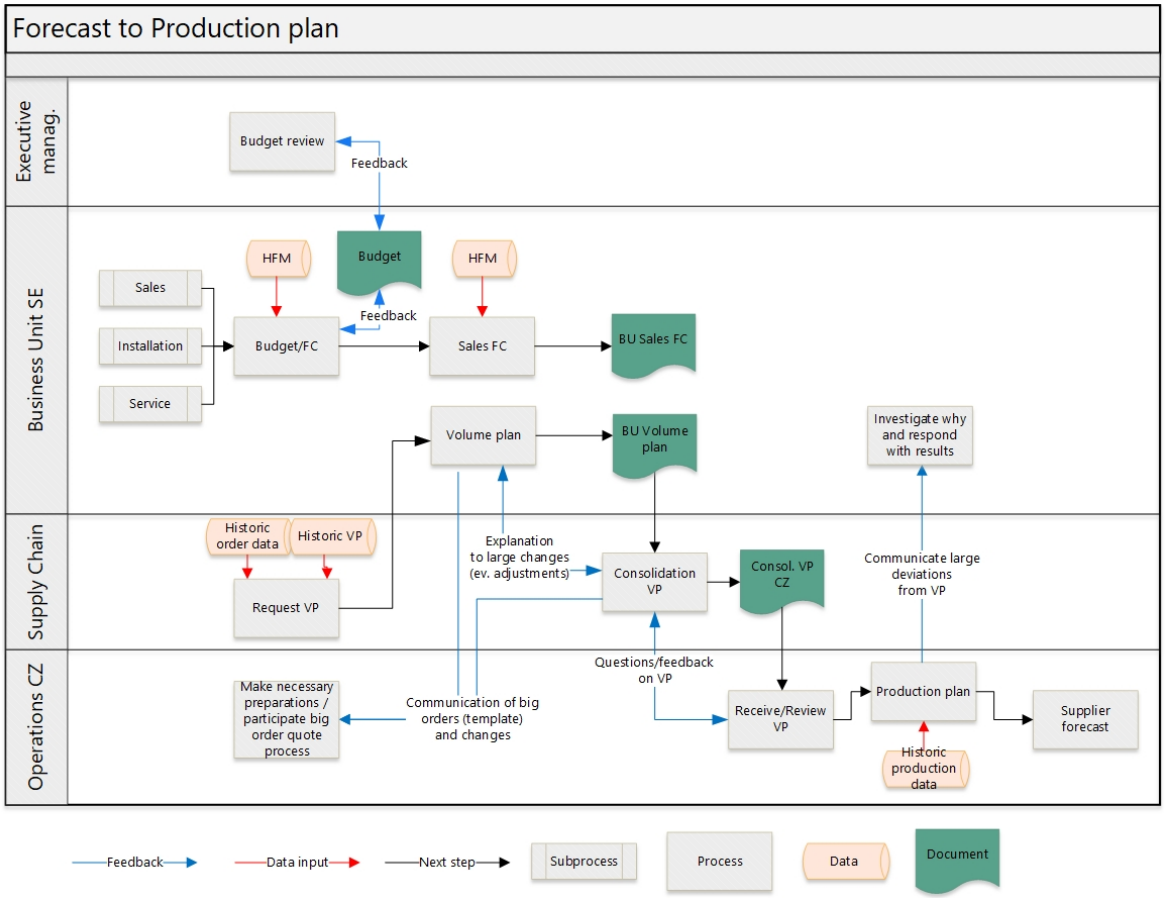

Figure 4.5: Forecast to production plan at ASSA ABLOY PDS.

agement, inflation, changes in salary, big project and other general costs are factors taken into account. This is done by each BU management. The financial manager is then presenting the proposed forecast/budget to the steering group in the BU and a final consensus meeting is held for all managers to agree to the proposed budget and forecast. In this activity, the forested sales plan is presented in the entity of money, no consideration of the volume of units is taken.

The forecasts and budgets from each BU are submitted to ASSA ABLOY PDS global financial reporting service, HFM. Budget review meetings are held together with one of the commercial directors of ASSA ABLOY PDS executive management, BU manager and BU financial manager. In this meeting, the executive management challenge the submitted budget and verify the budget´s alignment with the strategy of the corporation.

Sales forecast (SFC)

To give upper management an update on sales, all BUs conduct a SFC once a week for the current month. The SFC highlights changes in short term demand with the entity of money. The BU uses the SFC to validate the match between budget and financial forecast, to actual sold equipment and service. The forecasts are updated with respect to order backlog, quotes, hit-rates and special circumstances such as big

orders and other unexpected events. Employees participating when conducting the SFC varies between BUs. In the investigated BU, BU Sweden, the sales manager, service manager, financial manager and the BU manager collaborate to establish the SFC. The forecast is then reported into ASSA ABLOY PDS global financial reporting service, HFM.

BU volume plan
Each BU produce a Volume Plan (VP) on product level each quarter upon request from the Global Supply Chain (GSC) department. The prognoses are made in units on product level, unlike the budget and SFC which are based on product group level sales revenue. Each BU are provided with the last fours quarters' production data together with hit-rates of BU's forecast on those quarters by the GSC master planner. Financial manager and BU manager together develop the new VP based on the provided production data. Consideration is mainly taken to 3 month rolling quote trends, but 12 months rolling quote trends, big upcoming projects and the "gut feeling" about the current market have a minor impact as well.

GSC master planner collects and analyses the VP from each BU. If large deviations are detected the GSC master planner requests motivations from the BU in question. The forecast is updated with consideration to errors found and re-evaluations from BUs. Lastly, all VPs are consolidated and the total demand is divided onto each production site based on region of demand and product type. Large upcoming orders are communicated to the corresponding production site. In some cases the production sites are involved or at least continuously updated in large quotation processes.

It was found that in some cases are the consolidated VP, before distributed to the plants, evaluated and altered by key people in ASSA ABLOY PDS' executive management: supply chain director and president. Usually, the VP is reduced by a percentage in this stage. The reduction procedure suggests recurrent inflated numbers and mistrust in forecast.

Production plan
Master planner at production site, in this case the Czech site, retrieve VP and some explanations to larger volume changes from GSC master planner in order to plan upcoming production. The VP is reviewed once more with respect to large changes and volumes of products with previously deviant forecasts. Alterations could be made after consultation with GSC master planner. The production plan is then divided on weeks by assigning each week a seasonality factor. The factors are determined by historic data from the last three years and are average percentage of the yearly volume produced that week.

Receivers of the finalized production plan is the plant management. The production plan act as basis for capacity planning. Hence, head count and capacity investments are mainly affected by the production plan. Production scheduling are made with actual orders as input.

Material planning
ASSA ABLOY PDS employs a Demand Driven Material Requirment Planning (DDMRP) approach to set replenishment buffers and order ranges for each SKU, i.e. stock levels. The replenishment buffer of a specific SKU is determined by it's lead time, minimum quantity order, average daily usage (ADU), item type, lead time category and variability category. The latter three factors are set depending on which categories the SKU belongs to. Most of the factors are determined by historic production data and some are negotiated with suppliers. The factor ADU is the connection to an S&OP process, where it can either be determined by historic data or forecast. Currently, ADU is determined by forecast on products in categories "in development" and "soon to be launched". Some "active products" are partly determined by forecast where large shifts in demand is suspected.

Supplier forecast
Based on request, suppliers are given material forecasts on upcoming demand from the CZ production site. Quantities are presented as a monthly usage. The forecasted number are based on the production plan, hence a direct connection to the initial forecast made by BU. CZ evaluate each supplier on On-Time-Delivery and quality is measured randomly.

4.2.7 Cross-functional meeting and collaboration

The global departments work closely with the local departments, but also cross-functional in order to meet and fulfill existing synergies. Still, the silo culture within the company is quite strong, especially between the BUs and supply chain department. The lack of transparency leads to unawareness and misalignment, which results in sub-optimal decisions. The BU manager in Sweden expressed that the level of collaboration differed over the organisation and that geographical placement in some cases had a strong impact. Since the Swedish BU is located in the same building as the global departments, they can exploit informal communication which other BUs located elsewhere can not.

The core of the observation is the need of a standardized and formal S&OP process. However, in some cases the organisation has solved communications or alignment issues by arranging collaborations of their own, sometimes without involving executive management. They are both of formal and informal character. Collaboration initiatives by executive management could qualify as S&OP related activities and we would like to underline these.

Starting with initiatives by executive management, the large order quotation process is a great example of current collaboration. Before large quotes are made, e.g. delivery of door solutions to a renovation of a hospital, are operations and supply chain involved in the process. The goal is to keep all departments informed on the ongoing quotation process in order to minimize "surprises" in later stages. Stakeholder wins are: the supply chain department is prepared for large quantities of certain mod-

els with specific configurations and the sales departments know the supply chain department can fulfill their order. The initiative is relatively successful when the procedure is followed. However it's not fully embraced by the organisation and it has been difficult for BUs to present requested information in many cases, which suggests that the problem lays in acquiring information rather than sharing information.

The Czech production site has initiated monthly meetings with a number of BU with large order volumes. The purpose is to share information about and discuss upcoming demand, trends and large orders. Participants of the meetings are operations manager and BU managers. The collaboration connects demand directly with supply to some extent, but all functions in between are disregarded. However, a similar monthly meeting has been initiated by GSC master planner with the sales company Entrematic, who are responsible for a large part of sales of certain products.

As mentioned, there are many departments involved in the product development gateway process, where departments, such as operations and supply chain, provide feedback during process steps and participate in the gateway procedures. Even though this process does not qualify as a conventional S&OP activity, it shows that the right mindset is present in the organisation.

4.3 ASSA ABLOY PDS planning parameters

The identified planning parameters of S&OP-like processes at ASSA ABLOY PDS are presented in this section. Subsections are divided according to parameter type.

4.3.1 Planning frequency

ASSA ABLOY PDS has in their tactical planning forums various planning horizons. Every year, all BU's conducts three financial forecasts (FC1,2,3), four volume plans (VP0, VP1, VP2, VP3) and one budget, which is based on FC3. Planning frequency for FC, SFC, budget and VP are presented in table 4.1.

Table 4.1: Planning frequency at ASSA ABLOY PDS.

Type of plan	Planning frequency
Budget	Yearly
Financial Forecast	Three times a year
Sales Forecast	Weekly
Volume Plan	Quarterly

4.3.2 Planning horizon

The financial forecast's planning horizon varies from 6-15 months, this to reflect the budget time horizon. The SFC is the financial forecast broken down into months, and the SFC updates looks between 1 week and 1 month ahead. As for the volume plan, there is a horizon variation from 12 month up to 18 months. Long-term planning is based on *PDS Accelerate*, a global strategy developed by ASSA ABLOY PDS executive management.

4.3.3 Planning objects

ASSA ABLOY PDS has a total of four main product families, Swinger operators, Revolving doors, Slider operator and ADS systems where ADS systems refers to door solutions. Within those four product families there are 36 products, which all can be configured according to customer needs. These 36 products are composed of approximately 10000 different SKUs worldwide, some common for multiple products, but the majority is unique for one product.

The volume plan is made with respect to all 36 products. This is not the case for the budget and financial forecasts, which are expressed aggregated on product group level. Supplier forecasts are presented in SKU level, but these numbers are derived statistically from the production plan.

4.3.4 Units of capacity

In the Czech production plant the capacity limit of swinger operators, slider operators and ADS systems is expressed in units. The capacity is expressed on product level and differs significantly between products, but not as much between two configurations of the same product. For revolving doors, unit of capacity is expressed as man-hour due to large deviation in assembly time between different configurations of the same product.

The volume plan expresses products of all product groups in units. Notice the mismatch between units of capacity and planning units of revolving doors. The financial forecasts and budget are based on money and are made on product group level. The translation from these to production capacities is not obvious.

4.3.5 Time fences

There has been no identification of *formal* time fences for changes in plans at ASSA ABLOY PDS. Generally, larger changes in supply capacity are not made within 3 months due to supplier lead times. Hence, operations might reject orders from a BU if the quantity is much higher than forecasted quantity, and propose a new production date further into the future or divide the order in smaller batches to manage the large volume. There is also the costly option to use express freight with airplane to supply the factories with material.

5
Analysis

In this chapter, the analysis of the collected data is described. First, a case evaluation where issues and contextual factors of the company as well as the maturity of the current demand and supply balancing process are determined. Second, based on the contextual variables and issues, the design of the proposed S&OP process is derived as configurations that are added to the generic S&OP process.

5.1 Case evaluation

In order to provide an answer to *research question 2* and design an S&OP process, context variables and issues have been identified and the maturity has been assessed. This is presented in the following subsections: Identified issues, Identified context variables and S&OP maturity.

5.1.1 Identified issues

The main issues of the case company related to demand and supply balancing are derived from the information presented in chapter 4, Empirical findings. The issues are presented in table 5.1 and are related to deficiencies in the current demand and supply balancing process. Hence, potentially resolved by an effective S&OP process.

Table 5.1: Identified issues at ASSA ABLOY PDS which potentially can be resolved by an effective S&OP process.

Issue	**Causes**	**Pains**	**Receiver of pains**
Large raw material stock	Large amount of product variants, not good enough forecast accuracy and long lead times on raw material	Bound-up capital, occupied space in warehouse	Supply chain & operations
Large finished goods stock	Mainly due to customers rescheduling installation date, but also due to hedging behaviour	Bound up capital	Business units

Silo culture	Insufficient formal and informal processes for sharing information regarding demand on a regular basis	Information is kept within departments leading to more uncertainty within departments	All
Ineffective phase-out of products	Older products are continued to be sold in certain BUs and central phase-out initiatives are missing	Increases the number of SKUs (stock), operational complexity and supply chain complexity	Supply chain & operations
Budget financial forecast (FC) and volume plan (VP) are not connected	Made separately with no connection	Decisions based on budget does not consider volumes. Sales follow FC and supply chain follow VP, creates mismatch	Supply chain
Low commitment to volume plan	Lack of transparency: assumptions are not documented and low accuracy at a product level	Creates uncertainty in supply chain department, non-agreed changes to VP which could potentially end in delivery problems	All
Unforeseen demand spikes	Inability to communicate information of ongoing quoting processes and abnormal demand	Difficulty in meeting demand, increased stock due to lead time lag and increased freight costs due to express shipments of raw material	Business units, supply chain & operations

5.1.2 S&OP maturity

In this section, the maturity evaluation of the demand and supply balancing process at ASSA ABLOY PDS is presented. The evaluation is based on the empirical finding presented in section 4 and the maturity model by Grimson and Pyke (2007), presented in section 2.5.1. More specifically, quotes from Grimson and Pyke (2007) have been used to motivate the position of ASSA ABLOY PDS in the maturity matrix, see table 2.2. The determined maturity index is used as a contextual variable in section 5.1.3.

Table 5.2: ASSA ABLOY PDS's position in the S&OP maturity model by Grimson and Pyke (2007). The green boxes represents ASSA ABLOY PDS' position intervals in each dimensions.

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

Meetings and collaboration

The S&OP-like process at ASSA ABLOY PDS does not have a formal meeting structure on regular basis. However, in cases where BUs have signed extraordinary orders, a formal collaboration process with the supply-chain department were found. The global supply chain master planner acts as the communications channel between the supply chain department and the BUs by evaluating the forecasts and challenging the BUs on the stated volumes to bring consensus to the forecast.

> Stage 1: "Sales personnel develop very poor demand forecast. Operations then adjust these forecasts because they know that sales regularly inflates the numbers"
>
> – Grimson and Pyke (2007) p.331

This quote is for ASSA ABLOY PDS true to some extent. At a product level, the forecast accuracy is not very accurate. However, the total forecast at a product family level is acceptable, but the supply chain department does not trust the forecast enough to use it straight in operations planning. From time to time, the forecast is adjusted by the supply chain management without informing nor consulting the BUs. This is mainly due to inflated numbers.

> Stage 2: "sales and operations issues are discussed at senior management meetings [...] However, the discussion is primarily in the context of financial goals, rather than for the purpose of integrating plans."
>
> – Grimson and Pyke (2007) p.331

The top-management of ASSA ABLOY PDS develop sales targets for all BU. The BUs then develop plans to reach the sales target stated by top management. However, these plans are not evaluated against the supply side of business. The third stage entails monthly executive S&OP reviews and a formal S&OP team. ASSA ABLOY PDS lacks these conditions and therefore does not qualify for stage 3.

Organisation
As presented in section 4 Empirical findings, ASSA ABLOY PDS lacks a formal S&OP organisation and formal S&OP roles. Hence, the upper maturity stages, 4 and 5, can be clearly rolled out since these require a formal S&OP organisation. Looking at the other end of the spectrum, stage 1, we conclude that this stage is clearly passed since some of S&OP functions are fulfilled. For instance, the GSC master planner does follow-up on forecasted volumes from each BU, i.e. multiple and very informal one-to-one demand reviews are carried out. Important information is forwarded to key individuals within the supply chain and operations departments. Obviously, the demand reviews lack the presence of key individuals who may bring input, but the function is still there.

> Stage 2: "There is no formal S&OP function, but some of the tasks are fulfilled by others"
>
> – Grimson and Pyke (2007) p.332

Based on the explanation above, the descriptive quote above is clearly fulfilled which qualifies ASSA ABLOY PDS as stage 2 in the organisation dimension. The third stage requires an established complete S&OP function. However, the S&OP function is not owned and operated by a formal S&OP team, rather it is incorporated in one or several other roles at the company. ASSA ABLOY PDS does not have an entire S&OP process established, for instance the supply planning is missing. Hence, company can not qualify in the third stage.

Measurements
ASSA ABLOY PDS maturity regarding measurements is identified to be in stage 2. The quote below is accurate when describing ASSA ABLOY PDS measurements situation. Forecast accuracy is measured, but BUs are not held accountable for their plans and the forecast accuracy is not measured on a longer horizon than the last volume plan compared to current quarter. In stage 2, companies measure how well the operation manage to meet the demand plan. Within ASSA ABLOY PDS, there is KPI:s such as on time delivery, on time shipments and therefor is ASSA ABLOY PDS recognized to qualify as a stage 2 company in this category.

> Stage 2: "Assesses how well operations meets the sales plan, usually on quarterly or monthly basis. The issue here is that the sales managers are not held accountable for their plans"
>
> – Grimson and Pyke (2007) p.333

Information Technology
The maturity of stage 1 entails that, individual managers and employees keep their own spreadsheets by themselves without sharing them with others. Within ASSA ABLOY PDS, there are many spreadsheets owned by managers which are not shared. However, consolidation activities are present in the organsiation, e.g. the gathering of volume plans of each BU.

> Stage 1: "Companies has spreadsheets owned (but not shared) by individual managers, and there is no consolidation of information"
>
> – Grimson and Pyke (2007) p.334

> Stage 2: "Spreadsheets and data are separately owned and updated, but there us some manual consolidation"
>
> – Grimson and Pyke (2007) p.334

> Stage 3: "Companies centralize information in an automated way, and they employ revenue or operations planning software"
>
> – Grimson and Pyke (2007) p.334

This shows that ASSA ABLOY PDS is above stage 1. Stage 3 entails revenue optimization software and centralized data information. This is clearly not the situation at ASSA ABLOY PDS, and therefore the maturity of information and technology is regarded as in stage 2. The maturity has been recognized to be shifted towards stage 1 rather than stage 3 since the consolidated volume plan is only available for the supply chain department. Only the volume plan is consolidated, other data within the process are either shared in business reviews and not available to all participants in the demand and supply balancing process, or not shared at all.

S&OP Plan Integration
ASSA ABLOY PDS regularly makes forecasts on future demand and derives supply and production plans from the forecasts. Hence, the supply chain departments have rough understanding of future demand. ASSA ABLOY PDS clearly surpasses stage 1. It was observed that the BUs drives the company, which is visible in the supply and demand balancing process. Large changes in the demand plan are challenged by the supply chain department, but accepted if a valid motivation is provided. However, no operational constraints are considered and the demand plan is purely based on expected sales. The information flow goes one way and the supply and production plans are expected to meet the targeted demand.

> Stage 2: "... the sales plan drives the operations plan, and it is a on-way process ..."
>
> – Grimson and Pyke (2007) p.335

Obeying the descriptive quote would place ASSA ABLOY PDS in stage 2. However, one criterion does not match. In stage 2 are the plans made top-down, which is not truly the case at ASSA ABLOY PDS. At BU Sweden, the forecasted demand plan is made by an accountant and approved by the BU manager. It could be considered a bottom-up process in the sense that each BU develops its own volume forecast. On the other hand, the sales people of each BU are not involved in this process and the forecasts are heavily influenced by the financial goals set by executive management.

> Stage 3: "... employs a sequential process where sales plan primarily drives operations plan. However, some operational information may be used ... Stage 3 companies develop forecast bottom-up. The plans are then tempered by business and financial goals"
>
> – Grimson and Pyke (2007) p.335

According to the empirical findings, the operational information is not used when developing the demand plan. With the arguments from the paragraph above and the quote as input, we would categorize ASSA ABLOY PDS as a stage 2 company with some stage 3 partly fulfilled.

5.1.3 Identified contextual variables

The most important contextual variables identified have been summarized in table 5.3 in order to gain a clear view of how the S&OP process needs to be configured to fit the needs of ASSA ABLOY PDS. The choice of contextual variables is mainly influenced by the papers written by Kristensen and Jonsson (2018) and Bozutti and Esposto (2019). The contextual variables discussed in these papers are described in the Theoretical framework in section 2.2. Both enablers and inhibitors are considered, as well as specific needs and required functionality.

Table 5.3: Most important contextual variables for the configuration of the S&OP process.

Contextual variables	**Description**
Low S&OP maturity	ASSA ABLOY PDS lacks a formal S&OP process, implying that a whole new S&OP process must be designed and that the average employee's knowledge of S&OP within the company is low
DDMRP	DDMRP requires frequently updated valid information on upcoming demand in order to adjust and optimize raw material inventory levels
Multiple production sites	Difficulty to capture local supply capacities and issues in one big global meeting. The wanted level of detail is difficult to achieve
Multiple sales units	It is difficult to capture local demand in a large global meeting. Additionally, time-zones entail communication complexity

Global organisation	Generates difficulties associated with coordination of processes at local offices. Currently, forecasting is made differently in each BU. Similar issues are likely to arise when implementing an S&OP process
Build-to-order	Producing customer specific products in terms of color, dimensions and component configuration upon order. Generates complexity and entails difficulty in stocking the correct raw material and correct mix
Retail customers	Entrematic sell standard products and keep stock. The orders from Entrematic are often bulk orders with one product configuration which creates uneven demand
Quotation process	The major part of sales is done through quotation processes, providing valuable forecast information about upcoming demand
Large projects	ASSA ABLOY PDS supplies large construction sites with products, e.g. hospital renovations creating demand spikes
Long lead times upstream suppliers vs. lead time to customer	This makes it extremely important that the right mix of raw material is kept in stock
No. of products	ASSA ABLOY PDS has 36 products making up 6 product groups in their product portfolio. Following 36 products on a global level is time consuming
In-house product development	Phase-in of in-house developed products

5.2 Design of S&OP process

The configured S&OP process originate from a generic S&OP design derived from literature. The generic process has then been configured by applying CIMO-logic to contextual factors and issues identified found in the case.

5.2.1 S&OP generic design

The generic S&OP process is composed of the common characteristics from the different literature frameworks presented and reviewed in section 2.4. The unmodified generic S&OP process, figure 5.1, consists of four process steps: demand planning, supply planning, consensus meeting and executive review.

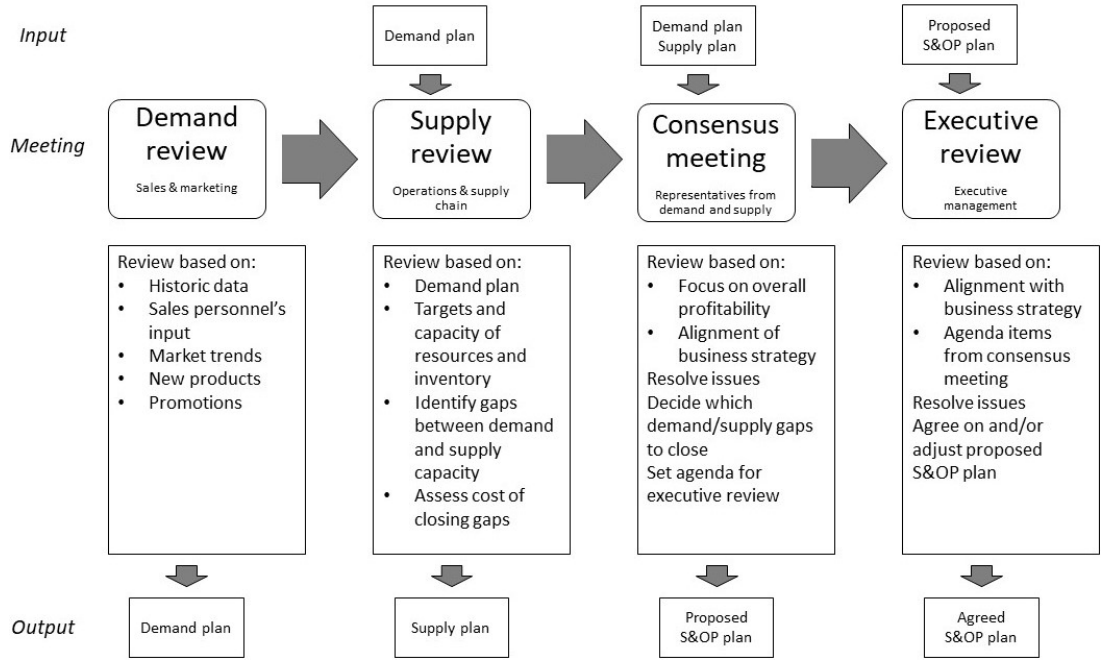

Figure 5.1: Generic S&OP process.

Demand planning

In the demand planning, the sales and marketing departments together develop an unconstrained demand plan, untouched by supply capacity, stating what the company will sell in within the planning horizon. Demand is determined by considering factors such as market trend and growth, historic sales data, the market knowledge from the sales force and sales promotions. The majority of the frameworks suggest initial forecasting in units and urge the importance of including the sales volume and effects of on current products caused by new products.

Supply planning

The goal of the supply planning is to determine current supply capacity by considering personnel, machine and inventory, in terms of capacity and targets. When capacity is determined, gaps between demand plan and supply capacity are identified and the cost of closings those gaps are assessed. The outcome is a plan for meeting, or partly meeting, demand and the cost of doing so.

Consensus meeting

The purpose of the consensus meeting is to align the demand and supply plan with focus on profitability. Resolving escalated issues from previous S&OP steps and setting the agenda for the executive review. The output is a proposed S&OP plan for executive management to approve.

Executive review
The executive review authorizes and approves the proposed S&OP plan. Adjustments are made if the plan does not correspond with the business strategy or if performance goals are not met. The meeting agenda is determined by the consensus meeting. Any issues which still are unresolved are discussed here. The output is an agreed S&OP plan, created bottom-up.

5.2.2 S&OP process: fit to context

In this section, the S&OP process is configured to fit the case context which is defined according to the previously identified contextual variables, table 5.3. The configuration is made by applying CIMO-logic to the contextual variables and defining desired outcomes. Interventions and mechanism are determined for each contextual variable in order to reach the desired outcome. The application of CIMO-logic to the contextual variables is described in the following subsections. In table 5.4, the corresponding intervention, mechanism and outcome are listed for each contextual variable. Each intervention represent an addition to the S&OP process and these are summarized in figure 5.2.

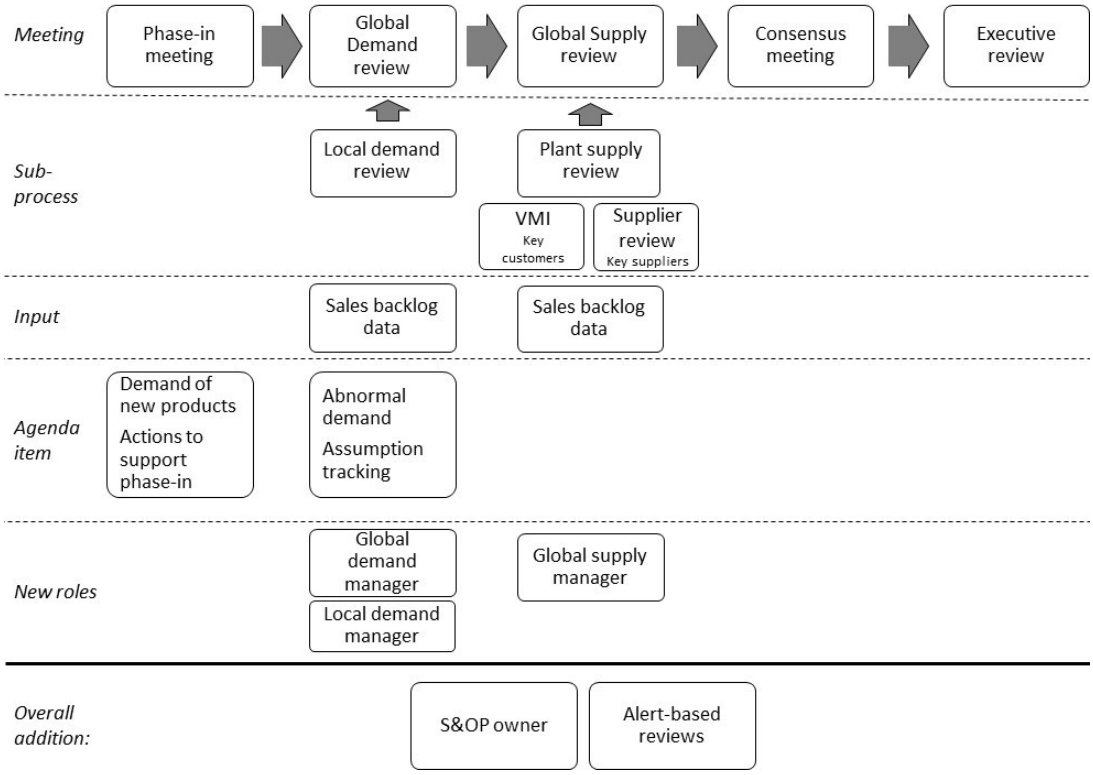

Figure 5.2: Contextual configurations of generic S&OP process.

Among the contextual variables in table 5.3, is "Low S&OP maturity" listed. This contextual variable suggest that there is no current S&OP process in place and therefore has an entirely new process been designed, rather than configuring a current one. This conclusion was made without the help of the CIMO-logic, hence why the contextual variable is not addressed in table 5.4. If an S&OP process were to be implemented at ASSA ABLOY PDS, the low maturity suggests training of the people involved in the new S&OP process to increase S&OP knowledge.

Table 5.4: CIMO-logic applied to contextual variables

Context	**Intervention**	**Mechanism**	**Outcome**
DDMRP	1.Share backlog data together with demand plan 2.Assumption tracking in demand review	1.Exploitation of available data 2.Highlighting abnormal demand	DDMRP uses all available information on upcoming demand as input
Multiple production sites	Plant supply planning and global supply planning	Local management, who work close to the production, are able to participate	Detailed evaluation of each plants' supply capacity and global consolidation
Multiple sales units	Local demand reviews and global demand review	Local sales personnel with market knowledge provide feedback to demand review	A process that permits detailed evaluation of local demand and provides a global perspective on demand
Global organisation	New roles with accountability for S&OP subprocesses: S&OP owner, Global demand planning manager, BU demand managers & Global supply planning manager	Accountability of process performance	Global process alignment
Build-to-order	Share backlog data	Exploitation of available data	Better knowledge of upcoming orders

Retail customers	Establish VMI with key customers	Real-time transparency of customer inventory and the ability to divide bulk orders	Even out production
Quotation process	Share sales backlog data: Quote and won quotes	Exploit available data	Better knowledge of upcoming potential demand
Large projects	1.Agenda item for abnormal demand (large projects) in demand review 2.Assumption tracking	Autonomous (1.)identification and (2.)documentation of abnormal demand in S&OP process	Abnormal demand communicated through the S&OP process
Long lead times upstream suppliers vs. lead time to customer	1. Share sales backlog data 2. Monthly supplier reviews	Ability to detect changes in product mix and secure capacity from suppliers	Increased visibility of upcoming product mix and configurations & ensure supplier capacity
Nr of products	1. On local level review demand mainly on product level and on global level review demand mainly on group level 2. Alert-based reviews	Focus on the important demand changes	Less time consumption.
In-house product development	Monthly phase-in review	Steer and support demand & supply planning	More effective phase-in process

DDMRP

The desired outcome is a DDMRP based on all available demand data in order to gain the best possible picture of upcoming demand. The BUs within ASSA ABLOY PDS have in their order backlog available order data, won quotes and on-going quotes with installation dates and configurations, which are not visible to the supply chain department. The first intervention is to share the backlog data continuously with the supply chain department which triggers the mechanism to exploit the data. The second intervention is assumption tracking in the demand review. The mechanism is highlighting of temporary demand changes in the forecast, which can be adjusted for in the DDMRP tool. Hence, using all available data on demand to configure the DDMRP variables.

Multiple production sites
The desired outcome is a detailed evaluation of capability of each plant to meet demand and a global consolidation of this demand. Wallace and Stahl (2008) suggest adding sub-reviews at a local plant level. For ASSA ABLOY PDS, this implies one global supply planning together with four plant supply reviews conducted locally at each plant. This entails that local managers, who work close to production, can participate and contribute with their knowledge in order to evaluate the local capacity and propose valid capacity recommendations. The supply from each plant can then be consolidated and discussed on a global level. This creates a supply plan created bottom-up.

Multiple sales units
To gather all BUs to participate in one demand review would be ineffective and would lack the detail of local demand needed to make an accurate demand plan. The fact that many of the BUs are not located in the same time-zone also makes it difficult for every BU to participate. The intervention is much like the previous intervention for "multiple production sites": adding local BU demand reviews where all BUs delivering their own demand plan which is aggregated and reviewed in a global demand review. This triggers the mechanism of local sales personnel's feedback in local demand reviews. Hence, local market knowledge is incorporated in the developed demand plan.

Global organisation
When developing the volume plan, there is currently no standard forecasting method used within ASSA ABLOY PDS. This is an example of one of the difficulties associated with global organisation, process alignment. Geographical distance, cultural differences, time zones are factors making it difficult to manage organisations spread worldwide.

Wallace and Stahl (2008) suggest therefore assigning the role of *S&OP owner* to one of the executive managers in order to increase commitment to the S&OP process and to coordinate the process steps. To support the S&OP owner and support the forecast process further, ASSA ABLOY PDS should employ a *global demand planning manager* who is accountable for the demand planning process. At the supply side of the process, a *global supply planning manager* role is suggested to improve the supply planning process and keep the process aligned between the four production plants. The global demand and supply roles function as the communication channel between the BUs and the supply chain departments.

To ensure accountability at a local level, process ownership of the individual BU demand plans and the plant supply plans should be assigned to the new roles BU demand managers and the already existing roles local master planners. BU demand manager is not full-time employment but rather a title assigned to existing employees. By this intervention, global process alignment is the intended outcome. Accountability of the process' performance is the mechanism triggered by these interventions.

Retail customers
Entrematic's bulk orders of products with the same configurations are from the operations department's point of view devastating. Not only does these orders highly affect current variant mix, but they also create large demand spikes which are difficult for operations to manage. Operations are not able to deliver these bulk order within lead times.

The wanted outcome is to be able to even out the production of these bulk orders. Ptak and Smith (2018) recommend VMI for upstream suppliers, and the same would go for large stock-keeping customers as Entrematic. The intervention is to initiate a VMI for Entrematic. This enables real-time transparency of customer inventory and ability to divide bulk orders into smaller portions of production orders over a longer period. This results in a less uneven production flow with less demand spikes.

Quotation process
For a majority of sales, there is a quotation process. In the process of balancing demand and supply, this can be an advantage because all quotes already have data of which product and type of configurations the customer is interested in buying. Applying the intervention of sharing on-going quote data triggers the mechanism of exploiting available data. This allows operations to gain more knowledge about upcoming demand.

Build-to-order
For build-to-order manufacture, literature suggest a focus on backlog targets in the S&OP plan in comparison to a make-to-stock manufacture which would focus the S&OP plan on finished good (Wallace and Stahl 2008). However, backlog targets for a build-to-order company is not a revolutionary idea and could even be considered obvious. Hence, it is suggested that the S&OP addresses the complexity in stocking the correct raw material mix due to the build-to-order strategy by utilizing information available in the quotation process.

Large projects
From time to time, ASSA ABLOY PDS sells products to very large renovations and construction projects, e.g. the construction of a hospital. Often, these large orders entail large quantities of products with the same configurations. For the supply chain department to be able to handle such large demand spikes they need to know in advance about what product configurations are expected in order to adjust the inventory for the temporary change in product and variant mix.

The wanted outcome is that large order projects are communicated to supply chain when the BU initiate the quoting process. The S&OP process intervention is a standard agenda item for abnormal demand in the demand reviews and assumption tracking. This will trigger an autonomous identification and documentation of abnormal demand through the monthly S&OP process.

Long lead times upstream suppliers vs. lead time to customer
ASSA ABLOY PDS decoupled lead times from suppliers in China are long compared lead time to customer. This makes it extremely important that the right mix of raw material is kept in inventory. Together with large projects and other demand spikes, the uncertainty of future demand needs to be minimized.

The outcome is to bring visibility to the upcoming mix of configurations of products. According to theory, transparency between sales and operations is reached when sharing sufficient data and information. The intervention to reach this outcome is to share the sales backlog where future configurations of product are visible. The mechanism will then be the ability to detect changes in product mix in future demand earlier.

Number of products
ASSA ABLOY PDS has 36 product in their product portfolio, but because there is almost no regulations of the configurations the customers are able to make, the number of unique products are much more than 36. This increases the complexity of keeping the right raw material mix in stock. Also, forecasting all individual configurations is too detailed and will most likely result in a poor forecast accuracy.

The outcome is defined as less time spent on reviewing and conducting the forecast and this is achieved by two interventions. First, the local BU demand planning will be conducted at a product level and the main focus of the global demand planning will be at a product group level. Second, alert-based reviews where the forecasts are reviewed at a group level. Where either historic or future deviation in demand is high, triggers an alert and the demand is reviewed at a product level. The mechanism triggered is the ability to focus on the most important changes in demand.

In-house product development
The R&D department develops the product of ASSA ABLOY PDS future product portfolio. When launching a new product, new demand has to be evaluated in order to match production capacity accordingly. Other phenomena such as cannibalism needs to be considered as well. The intervention of having monthly phase-in review meetings where roles such as product owners, global demand planning manager and global supply planning manager participate, supports phase-in by reviewing the current product portfolio together with new product introductions, forecasting demand of new products and providing information and supportive actions when new products are launched. The mechanism triggered is support to the rest of the S&OP process which enables a more effective phase-in process.

5.2.3 Configure to resolve experienced issues

To at least partly resolve the identified issues in table 5.1, the corresponding *causes* are addressed by the CIMO-logic. The addressed causes are presented in the following paragraphs and the CIMO-logic is summarized in table 5.5. Each intervention corresponds to a configuration of the S&OP, which are presented in figure 5.3.

Table 5.5: CIMO-logic applied to causes in order to resolve or reduce impact of identified issues.

Context	**Intervention**	**Mechanism**	**Outcome**
Insufficient forecast accuracy	1.Use forecast accuracy and bias as KPI. 2.Initial statistical forecast with adjustments where needed	1.Induced accountability on forecast owner (sales). 2. Influence from both historic data and market knowledge	Improved forecast accuracy
Hedging behaviour	S&OP process	Increases service level	Reduced hedging behaviour (Bower 2006)
Lack of formal communication channels	S&OP process	Implementation of S&OP entails formal communication	Utilized formal communication channels
Lack of central phase-out initiatives	Monthly phase-out review	Phase-out issues highlighted and discussed	Central support actions to realize phase-out
Separately made budget and volume plan	Set 18 months S&OP planning horizon	Possibility to avoid extra work by using existing forecast	Budget based on S&OP plan
Lack of transparency in forecast	Assumption tracking	Possibility for stakeholder to review forecast assumptions	Transparent and trustworthy forecast
Inability to communicate abnormal demand	Agenda item for abnormal demand in demand review	Forcing participants to reflect upon abnormal demands	Abnormal demand communicated through the S&OP process

Insufficient forecast accuracy causes large raw material stock and low commitment to forecast. By introducing forecast accuracy and bias as KPI, the accountability of the process forecast owner increases. However, time consumption of forecasting is still an issue. Wallace and Stahl (2008) propose the creation on an initial statistical forecast, which is overridden where appropriate with respect to market knowledge. By doing so, statistics is utilized together with market knowledge and accuracy is potentially improved. The forecasting should be supported by software to obtain statistical forecasts of good quality and reduce time compared to today's time-consuming process where forecasts are manually consolidated. Integrated information gathering from the sales ERP-system would be beneficial as well.

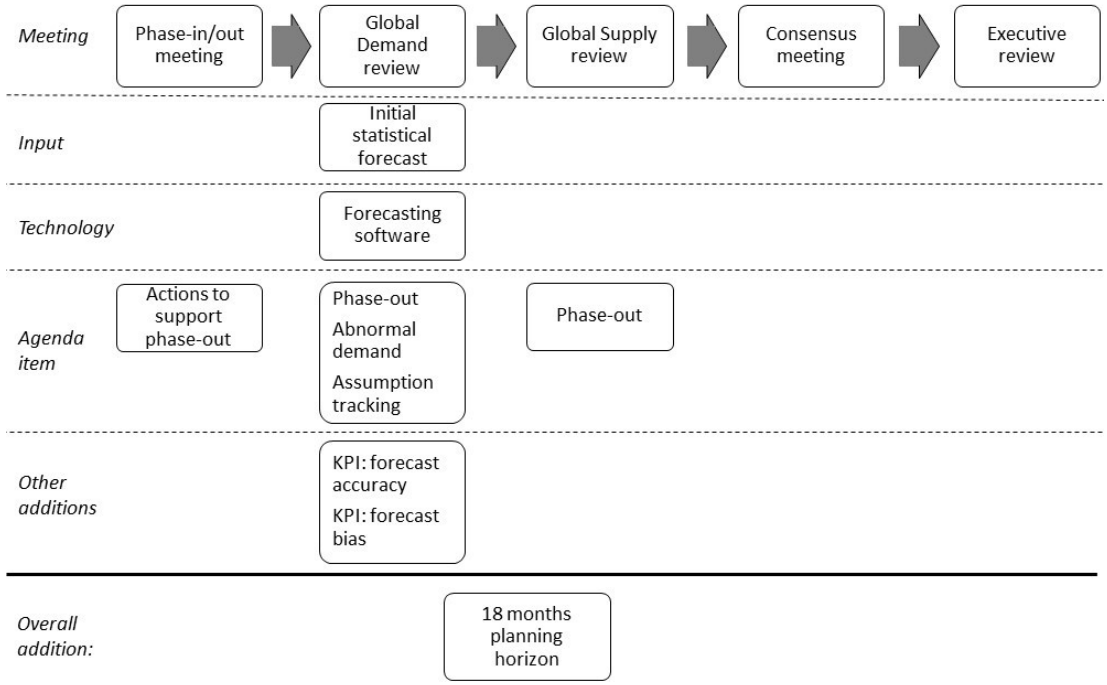

Figure 5.3: Configurations of S&OP process based on identified case issues.

Hedging behaviour, referring to the behaviour when personnel over-inflate volume of orders or place orders earlier than necessary to avoid stock-outs (Bower 2006). In this case, BU sets delivery dates of finished products somewhat earlier in order to safeguard against late deliveries from factory, hence increasing stock of finished goods. An effective S&OP process increases service levels (Bower 2006), which builds up trust among the material planners. This reduces hedging behaviour.

Lack of formal communication channels causes silo culture where important information is not shared between departments. The S&OP process itself is a large communication channel for important information regarding demand and supply balancing. Implementing a formal S&OP process entails increased communications over departments.

Lack of central phase-out initiatives causes ineffective phase-outs where certain BU fail to phase-out old products. Adding phase-out to the agenda, facilitating follow-up on phase-outs and supportive actions from global management.

Separately made budget and volume plan causes misalignment between budget and volume plan. By setting an 18 months S&OP planning horizon can the S&OP plan act as base for the budget. The incitement for using the S&OP plan as basis for budget when possible is simple: it entails less work since no extra forecast needs to be made.

Lack of transparency in forecast causes low commitment to plan. Bringing transparency to the S&OP plan by documenting and attaching all assumptions made in the creation of the S&OP plan results in trustworthy forecast which stakeholders are willing to commit to, assuming the assumptions are reasonable. Another perk of assumption tracking is the possibility to correlate assumptions to errors in forecast when evaluating forecast.

Inability to communicate abnormal demand causes unforeseen demand spikes. Introducing *abnormal demand* as an agenda item in the demand review forces the participants to reflect on abnormal demands. This creates a organisation where abnormal demand is autonomously identified and communicated.

5.2.4 S&OP planning parameters

This subsection is dedicated to motivating the configuration of S&OP planning parameter, introduced in chapter 2 Theoretical framework. Some of the parameters have been addressed by the CIMO-logic, while the majority has not. Setting the planning parameters is more straight forward than configuring the whole S&OP process, hence why the CIMO-logic has not been applied here. However, the choice of S&OP parameters is still based on company contexts.

Planning frequency As stated in the chapter 2 Theoretical framework, literature suggests planning on a monthly basis, or even more frequent. Frequent planning allows the company to catch fast changes in demand. When entering an implementation process, frequent planning entails lots of practice which helps the company to learn faster. Hence, a monthly planning frequency is suggested.

Planning horizon As theory shows, the planning horizon depends on the company context. ASSA ABLOY PDS has a seasonal demand. Due to the seasonal demand and to be able to connect the budgeting to both demand and supply plan, ASSA ABLOY PDS S&OP planning horizon has to be 18 months or more. Also, the planning horizon is dependent on the lead time of large project. Some of the large projects do have lead times of over one year which proves that the planning horizon needs to oversee 12 months.

Planning objects Planning at a product group level is the most common recommendation in theory. However, ASSA ABLOY PDS' family groups does not share a lot of common components. Hence, the product mix is of high importance, suggesting a focus at a product level. As already discussed, ASSA ABLOY PDS has relatively few products which makes it possible to discuss demand at a product level in BU demand review and plant supply review. Statistical forecasting, created by software, should be made at a product level. For the global meetings, product groups should be used in order to reduce meeting time but the possibility to discuss individual products is needed. To summarize, planning at local levels should focus at a product level while the global meetings focus at a product group level.

Units of capacity Theory recommends using units of capacity that can be compared to the planning objects. ASSA ABLOY PDS are using units that can be produced per shift for five of the six product groups. This can easily be aggregated into total units of capacity of the planning period and be compared to the planned object in the demand plan as theory suggest. The sixth product group, revolving doors, uses the units of capacity expressed as man-hours instead of units. This makes the comparison between planning object and capacity more difficult. To be able to compare planned objects and capacity, an average of man-hours per unit has to be calculated. Because there are large deviations in assembly time, revolving door capacity would benefit from being expressed in units per shift with it´s corresponding standard deviation to highlight the irregularity.

Time fences In theory, time fences should be used and based on the decoupled lead time from suppliers. Because time fences is related to specific stock keeping units, it can be difficult to discuss individual time fences. Therefore, theory suggest setting general time fences for one product or a whole product group. The individual products or product groups can also have different time fences according their individual decoupled lead time. Theory also suggest having multiple time fences for the same product related to how much demand is allowed to fluctuate during that period. ASSA ABLOY PDS has as mentioned long lead times from upstream suppliers. Therefore, the time fence within the decoupled lead time should be set to the raw material availability of the specific products.

5.2.5 Proposed S&OP process design

In figure 5.4, the complete proposed S&OP process design is presented. Also, in table 5.6, the planning parameters to the new S&OP process are shown. The result is derived from combining the generic process together with context-based intervention and interventions to resolve ASSA ABLOY PDS issues.

Table 5.6: Planning parameters of proposed S&OP process for ASSA ABLOY PDS.

Planning parameter	**Setting**
Planning frequency	Monthly
Planning objects	Focus on product level at local levels and focus on product group level at global level
Units of capacity	Units produced per shift
Planning horizon	18 months
Time fences	Decoupled lead time for individual products

Besides the configurations of the S&OP process, new roles have been introduced, table 5.7. In section 5.2.2, the different roles are introduced and motivated, however their assignments are not specified. Preferably, the S&OP owner should be independent from the supply chain and sales departments to minimize bias. Besides

being accountable for the S&OP process as a whole, the S&OP owner chairs the consensus meeting and the executive review, while the global supply and demand planning managers chair the global supply and demand reviews. The global supply and demand planning mangers own their respective processes and are in charge of implementing and improving them. They also have the responsibility to coordinate and support the local master planners respectively the BU demand planners. The BU demand planners are assigned to prepare the local demand review by collecting data, proposing a new demand plan and document assumptions. The local master planners have similar tasks but towards the plant supply planning.

Table 5.7: Introduced roles.

New roles	**Responsibility**
S&OP owner	Sponsor of S&OP process
Global demand planning manager	Ownership of global demand planning process
BU demand planner	Ownership of (local) BU demand planning process
Global supply planning manager	Ownership of global supply planning process

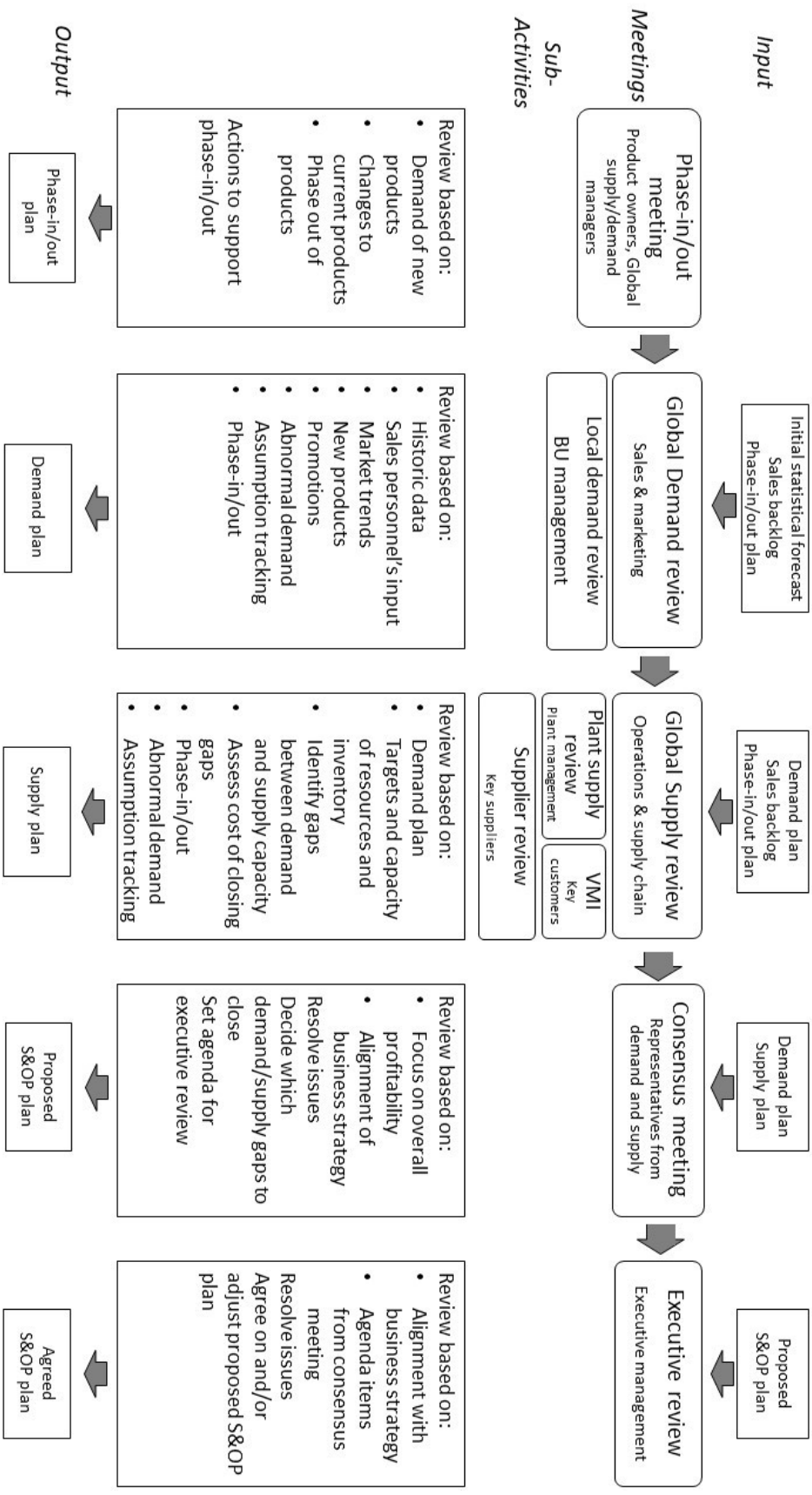

Figure 5.4: Configuration of S&OP process for ASSA ABLOY PDS.

6

Discussion

6.1 S&OP benefits

A majority of S&OP related papers highlight at least one or two benefits associated with an effective S&OP process. The literature often lacks descriptions of which process step or activity the benefit origins from or if they only are achieved in certain context. However, for some of the benefits the literature provides both origin and if the benefit can be gained regardless maturity of the S&OP process.

From literature, twenty benefits associated with S&OP were found, eleven hard benefits, table 2.3, and nine soft benefits, table 2.4. Many of the found benefits are a result of the complete S&OP process rather then one S&OP process steps. From an implementation aspect, this results in not achieving many of the benefit before having a complete S&OP process implemented. Therefore, it is important to sponsor the implementation and educate all employees in order for the process not to die out before fully implemented due to lack of benefits Wallace and Stahl (2008).

Improved forecast accuracy is one of the most recurrent benefit throughout the literature. Authors are relatively unified about how this benefit is achieved. It is mainly the level of effort put in to the forecasting process. Improved forecast accuracy is a fortunate benefit since it is measurable and improved through the demand planning, which arguably is likely the first process step to implement. In build-to-order environments, it is evident that more effort in assumption tracking and market knowledge is needed to achieve improved forecast accuracy.

Reduced inventory and obsolete inventory is also a recurrent in literature. The authors states that the biggest contributor to having to large inventory is uncertainty in demand and hedging behaviour in both sales and supply organisations. The case confirms this by that the supply chain department mistrust the forecast and therefore keep higher raw stock material to ensure high service level. This benefit can be argued for to be a result of the previous benefit, *improved forecast accuracy*, since one of the contributing factors for obsolete inventory, hedging behaviour, is likely to be reduced when trust in the forecast increases. Literature also states that the cross-functional communication reduces hedging behaviour. Although, it can be argued for that cross-functional communications alone does not reduce hedging behaviour but together with *improved forecast accuracy* and increased trust it does.

From the category soft benefits, the most recurrent benefit is *supporting focus on long-term strategy & growth plans for supply chain, sales and the overall business.* One can think that this benefit would be achieved only by companies that have an advanced S&OP process. However, this benefit is according to Jonsson and Lindau (2019) also experienced by immature and mature companies. In companies liken the case where continuous growth is crucial, this benefit alone can be argued for to implement and carry out a S&OP process.

In the study, issues that potentially could be resolved by an S&OP process were found. The generic S&OP process were then configured in order to resolve issues and fulfill found S&OP benefits. Besides the benefits found in literature, the configured S&OP process resulted in one new undiscovered case specific S&OP benefit. It is in this section, generalized as propositions to add value to literature. The analysis shows that by initiate an agenda item in the demand review regarding abnormal demand would support cross-functional communication of such. This because the formal and monthly demand reviews investigate if there is upcoming abnormal demand or not. It is then communicated through assumptions stated in the demand plan. Sheldon (2006), Wallace and Stahl (2008), and Jonsson and Lindau (2019) supports this by stating that *communication and feedback between and within sales and supply chain departments facilitated* is an S&OP benefit. Therefore, with support in literature and the analysis, the first proposition is as follow:

> **P1**: Effective S&OP helps to identify abnormal demand patterns by enabling early communication and interpretation of external conditions and business intelligence between sales and operations.

For instance, when there is a sudden sale of the magnitude that is categorized as abnormal demand the S&OP process provides the ability to formally monitor and communicate the abnormal demand throughout the company. Ensuring that all stakeholders that should be aware of the abnormal demand also is.

6.2 Configuration of S&OP process

A proposed S&OP process with configurations based on the contextual variables and issues of ASSA ABLOY PDS has been developed in order to answer RQ2. The proposed S&OP process design is presented as a whole in figure 5.4. As presented in the analysis, the configuration has been divided into two steps. First, the S&OP process was configured by applying CIMO-logic with respect to identified contextual variables in order to fit the process to the company context. This was necessary since contextual factors need to be considered in order to create an effective process and potentially gain promised benefits. Secondly, identified issues related to demand and supply balancing were addressed. More specifically, the causes for each issue were addressed by applying CIMO-logic to these and deriving interventions and mechanism. The second round of CIMO-logic was carried out in order to ensure that resolution or reduction of each case issues were addressed since these are the main drivers for an potential implementation.

The S&OP process configurations are valid for ASSA ABLOY PDS, but not for an arbitrary company and therefore itself not an addition to the research. In order provide to addition to the academic area of S&OP process design, the configurations need to be generalized. However, the configurations still need to be rooted in contextual variables. If not, the configurations are not of more value than the generic S&OP process and the purpose of this study is not fulfilled. Hence, a set of configurations based on general company characteristics has been provided in the following propositions.

> ***P2****: In an organisation with multiple demand units sharing multiple production units, local reviews should be employed and the outcome should be aggregated and discussed in global reviews.*

For instance, multiple sales departments entails difficulty in conducting the demand planning on the needed level of detail since this would imply many participants and very time consuming meetings. By dividing the demand planning process in local sub-reviews and then aggregate local demand into one global meeting, local knowledge of demand is discussed as well as the big picture. The same concept applies for the supply planning process. Both Wallace and Stahl (2008) and Ptak and Smith (2018) suggests a similar configurations. In their systematic literature review, Kristensen and Jonsson (2018) found several papers on the matter of dividing the S&OP process into multiple S&OP processes and suggests it is common among companies employing S&OP. However, not necessarily similar to the division of the S&OP process proposed in this study.

> ***P3****: Large global organisations characterised by separated sales departments and production plants, both geographically and culturally, should employ global process owners of the demand respectively supply processes.*

When the organisation is spread across the world, difficulties in coordinating the S&OP process arises. In cases where several plants supplies the same multiple sales departments becomes the need of synchronized demand and supply process especially important. Employing global process owners for the demand planning process and the supply planning process facilitates coordination and development of the processes. In an global implementation phase of S&OP, the global process owners are especially useful. Using process owners to increase effectiveness is not new. For instance, it is discussed by Grimson and Pyke (2007), who suggest to select an S&OP champion, in order to increase the effectiveness of the S&OP process.

> ***P4****: Companies acting on markets characterized by abnormal demands should apply assumption tracking to their forecasting process by integrating market intelligence with the S&OP process.*

Abnormal demand is a large change in demand which is temporary. For instance, could an on-going promotion increase sales drastically temporally. By using assumption tracking when forecasting, the cause of the change in demand is documented and available for the supply organisation, which makes it easier for the supply organisation to commit to a sudden increased in volume. The market intelligence is integrated to provide information on market changes. Assumption tracking also forces the sales department to reflect on their causes for changes in demand.

> ***P5****: If the company acts on a market where quotation is custom, the quotation preparation process should be integrated with the S&OP process.*

When entering a quotation process, products, volumes and expected delivery dates may be included in the quote. This is information on possible future demand, which could be translated into resource and material capacity, which is useful for the supply organisation when planning future capacity.

6.3 Discussion of methodology

The chosen method for empirical data gathering where semi-structured interviews. This enabled the authors to elaborate areas of interest in a more flexible way than if the interviews were held in structured manner. It could have been preferred to use structured interviews to enable easier categorisation of the data gathered (Bryman and Bell 2011) and to facilitate reliability. However, due to the complexity of the demand and supply balancing process, it would have been difficult to define all needed questions prior to the interviews. Hence semi-structured interviews was concluded to be the most suitable method of choice. Observations is one method of gathering primary data (Björklund and Paulsson 2012). This method was considered but during the period of data gathering, there were no demand and supply balancing activities to attend, since they were conducted on quarterly basis. Questions regarding those activities where instead asked to the interviewees.

In total where 28 interviews conducted with 14 unique participants at ASSA ABLOY PDS. As mentioned in the methodology, triangulation was applied for most of the departments to ensure validity in the data gathered.

Due to the research area of S&OP configuration based on contextual variables being rather novel, a standard method to derive the S&OP configurations from contextual variables was not available. Therefore, in this study, CIMO-logic was used to find configurations to S&OP process. The CIMO-logic is an effective method to configure an S&OP process to the specific contextual variables and experienced issues. However, S&OP process for ASSA ABLOY PDS has not been implemented nor tested.

6.4 Consideration to societal and ethical aspects

S&OP is a coordination mechanism that aims to balance supply and demand by using tools such as are simple communication, formal meetings and collaboration between departments (Grimson and Pyke 2007). Even though the aim of S&OP could be maximising profitability in certain companies, the process does not contain any headcount reduction. In fact, could an effective S&OP process benefit the employees, since the number of overtime hours due to last minute orders could be reduced.

When conducting interviews, it is of importance that the interviewees are informed on the intentions of their input and they consent to it (Bryman and Bell 2011). Hence, before starting each interview, the interviewee was informed about the study and intended outcomes. Names of the interviewees were left out of this report to respect each individual. The interview notes were neither published nor read by someone else than the authors. Eventual critique has not been directed towards individual or groups of employees, only towards organisational structures, processes, company policies or similar.

7
Conclusion

S&OP is widely agreed upon to be an important element in today´s industrial environment were companies experiences volatile markets and increasing supply chain complexity. The many benefits associated with an effective S&OP found in this study give evidence to that the S&OP process enables focus on profitability and company growth rather than objectives of the various departments. The ASSA ABLOY PDS organisation had the intention to learn what an S&OP process was for ASSA ABLOY PDS and what benefits to potentially gain. With that said, this study has developed and configured an S&OP process to fit ASSA ABLOY PDS's contextual variables that potentially resolve their experienced issues related to demand and supply balancing. A set of configurations of the generic S&OP process has been made according to the CIMO-logic to gain the associated S&OP benefits. The final configuration for ASSA ABLOY PDS can be seen in figure 5.4.

The theoretical contribution of this study lies within the five propositions generated from the configured S&OP process. Kristensen and Jonsson (2018) suggested further case studies that explores and explains the effects of contextual variables on S&OP design. Proposition **P2-P4** add insight to how the S&OP process should be configured according contextual variables. **P1** will be an addition to the answer of RQ1, where S&OP benefits were derived from literature.

One of the major limitations in this study is that the configured S&OP process has not been tested nor implemented. Even though issues and contextual variables are derived from the case, the configurations originate entirely from the CIMO-logic and recommendations in S&OP literature.

The S&OP process has been configured with respect to found and selected contextual variables. There are obviously more contextual variables which one might consider. These where either not found in this study or considered small and less important. Including small details would quickly add up to a lot of work and would result in very specific configurations. One could argue that these would become to specific and that the level of academic relevance would decline, since the contribution needs to be generalized to some extent in order to be applicable for other researchers or companies.

As for future research, we suggest two areas which need to be explored further. First, further design science studies of S&OP process designs for companies with different contexts are suggested in order to expand the collection of suitable S&OP config-

urations based on contextual variables. A valuable addition to literature would be a vast collection of contextual variables with suitable S&OP configurations. When facing an S&OP process configuration in the future would such a framework be of great use and reduce the amount of work needed to configure an S&OP process. Secondly, studies of implementation of S&OP processes configured based on contextual factors in order to empirically determine whether or not the configurations are valid or not.

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A

Appendix

A.1 Template for Process Mapping

The template used in the study to map the current demand and supply balancing process at PDS.

Activity name:		Departement(s):		Frequency:	
Description		Purpose		Responisble Person	Participants
Supplier of input	Input	Tools	Actions	Measurement	Output	Reciever of output

Extra notes

Figure A.1: Template for process mapping.

A.2 Questions from Case Study Protocol

- What's your role in the demand and supply balancing process?
- What do you believe is the goal with the process?
- Who is involved in the process?
- Do you think that the demand and supply balancing process is
- aligned with business plan?
- If you would choose, what would you like to improve with the process?
- Is there a process owner?
- is there a formal team for the process?
- Is there any from senior management involved in the process?
- In which process steps are there decisions made?
- Are there any suppliers involved in the demand and supply balancing process?
- What inputs do you use from the forecast?
- Can you tell us about the products?
- How many types of doors do you sell?
- How many product families are there?
- How are the product families composed?
- Is the process measured?
- What KPIs are associated with the process?
- How do you carry out the forecasting process?
- What tools do you use for conducting the forecast? Excel, software or other?
- How long does it take to conduct the forecast?
- In what frequency do you carry out each process step?
- What meetings are held on regular basis and how often are they held?
- What IT is used today?
- Is the sales organisation using ERP system?
- Are the systems that demand and supply side use linked?
- Are goals of each department aligned through the process?
- How is the organisation set up?
- How do you do the aggregation of all forecasts?
- Is there anything else in the context that you think is important to know about the process?
- What manufacturing strategy do you use?
- Who takes capacity decision and what is the decisions based on?
- Do you trust the forecasts?

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