Constructive Engagement in Sales and Operations planning

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Supervised by
Dr. O. Türetken
Dr. R. Kusters

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BSc. S.W.M. Moons
“Navigating a successful S&OP journey is 60% change management, 30% process, and 10% technology”
Chase (2013)
Management Summary

In this master thesis report a model of factors affecting constructive engagement in a Sales & Operations Planning (S&OP) process is proposed, including their respective relations. This model incorporates and builds on findings from related research, and is validated during an exploratory case study at an organization that has recently implemented a Sales & Operations Planning (S&OP) process.

The S&OP process is a tool for balancing supply and demand for the medium to long term. The process usually consists of four monthly-recurring meetings (Milliken, 2008; Olivia & Watson, 2010). Many articles have been written about this topic, with a noticeable increase in interest over the last five to ten years (Ambrose, 2015). Part of the increased interest can be attributed to increased operational complexity for manufacturing organizations displayed in Figure 1. By taking into account both the demand side and the supply side of operations, the S&OP process can mitigate the effects of operational complexity through increased information sharing and organizational alignment.

Although organizations are intrigued by the potential benefits of a S&OP process, many firms struggle to accomplish the intended performance improvements. According to previous research roughly 30 percent of S&OP initiatives fail to achieve the intended results (Milliken, 2008; Wagner, 2013). Difficulties in achieving cross-functional collaboration are believed to be the biggest obstacle in achieving improved performance (Ambrose, 2015).

Successful S&OP requires a great deal of teamwork and cross-functional collaboration (Braunscheidel & Suresh, 2009; Feng et al., 2014; Ambrose, 2015). This means people with different perspectives and functional orientations need to reach alignment to achieve a common goal. This combination of collaboration and functional conflict is generally referred to as constructive engagement (Ambrose, 2015; Olivia & Watson, 2011).

The objective of this research is to propose a new model of factors that affect constructive engagement in a S&OP context. Accordingly, the following research question is posed:

*What are the factors affecting constructive engagement in a S&OP process?*
With respect to this research question, an integrated model is developed that incorporates and builds on models proposed in previous research. The research work was initiated with a wide-ranging literature review to locate gaps in the current literature, and identify relevant factors enabling constructive engagement. Next, a case study was conducted to evaluate the model in a case organization. This approach was taken in order to provide the context-dependent findings needed for qualitative research.

The proposed model of factors affecting constructive engagement is presented in Figure 2. The model integrates the findings of previous work, and is validated during a case study at an organization operating in the high-mix, low-volume manufacturing industry. The external team factors centralization, top management support and resources & time, and the internal team factors social cohesion and superordinate identity directly impact constructive engagement. Constructive engagement affects the process quality factors procedural quality and information quality, and has a positive effect on S&OP performance. A reinforcing structure is included to represent how S&OP performance can motivate S&OP team members through incentive alignment, which in turn increases constructive engagement.

The findings of this research thesis have implication for both researchers and practitioners. The proposed model provides an integrated perspective on previous work in a S&OP context, and identifies the potential for future work to further validate and add to the model. Practitioners can benefit from the presented findings from an organization that was in the early stages of implementing a S&OP process. The factors in the proposed model can serve as a guideline for managers during a S&OP process implementation initiative.
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1. Introduction

In this master thesis report a model of factors affecting constructive engagement in a Sales & Operations Planning (S&OP) process is proposed, including their respective relations. This model incorporates and builds on findings from related research, and is validated during an exploratory case study at an organization that has recently implemented a Sales & Operations Planning (S&OP) process. During the case study a S&OP process redesign initiative was evaluated at an organization operating in the high-mix, low-volume manufacturing environment. The S&OP process is a highly social process that is dependent on the combination of cross-functional collaboration and functional conflict, referred to as constructive engagement. Constructive engagement is believed to play a crucial role in the success of a S&OP process. The variables affecting constructive engagement are identified using a comprehensive literature review, and are proposed in an integrated model. This model was analyzed and validated with the findings at the research organization. The remainder of this chapter holds the detailed research description, project scope, and project outline.

1.1 Research description

The S&OP process is a tool for balancing supply and demand for the medium to long term. The process usually consists of four monthly-recurring meetings (Milliken, 2008; Olivia & Watson, 2010). Many articles have been written about this topic, with a noticeable increase in interest over the last five to ten years (Ambrose, 2015). However, many of the articles originate from practitioners’ literature, which seems to have a tendency to describe best practice cases, but fail to identify the underlying factors of the success. Specifically, the development and early implementation of a S&OP process is largely undiscussed, while the potential benefits of S&OP and the different levels of maturity are discussed more extensively (Ambrose, 2015; Thomé et al, 2012). In order to achieve the intended benefits and develop a more mature process, an organization has to start with a very basic S&OP process that is supported by the team members (Wallace & Stahl, 2008). The high number of failed S&OP initiatives described in the literature indicates the difficulty of establishing even a basic S&OP process, and provides the motivation for further research in the crucial early stages of the development and implementation of a S&OP process (Singh, 2010; Grimson & Pyke, 2007).

The S&OP process is embraced by a great variety of organizations ranging from fast moving consumer goods producers to capital goods manufacturers (Milliken, 2008; Olivia & Watson, 2010). This research will focus on capital goods manufacturers, since it is thought that S&OP can provide an especially valuable tool for this type of producer. Recent developments have greatly increased the operational complexity for manufacturers (Laurent Lim et al., 2014). Customers expect a capital good to meet their unique needs to a large extent. This has led to an increase in the number of products a manufacturer has to offer, and a resulting decrease in the number of sales per product. This has led to capital good producers operating in a high-mix, low-volume manufacturing environment.

Forecasting is a crucial, if not the most important, component of S&OP (Wallace & Stahl, 2006; Wagner, 2013). The main intended goal of S&OP is to strike a balance between supply and demand, to achieve maximal revenue against the lowest possible cost, resulting in maximal profit. However, forecasting sales
numbers has proven to be a difficult task in a high-mix, low-volume environment. Low output means forecast errors are relatively large in terms of percentages. In most organizations the sales department is given the task to come up with accurate and reliable forecasts. This can lead to various levels of resistance. Since forecasts are almost inevitably wrong to some extent, sales manager might expect to receive criticism when forecasts prove to be inaccurate. This can decrease their willingness to cooperate during the early stages of S&OP process implementation (Milliken, 2008; Grimson & Pyke, 2007).

Another characteristic of a high-mix, low-volume manufacturing environment is the large number of suppliers. A typical firm can have hundreds or up to thousands of suppliers, each responsible for one or more parts that make up the final product. The supply chain department is responsible for maintaining a close relationship with suppliers, and keeping track of the capabilities of the supplier. Large increases of the typical order quantity may not always be possible due to the supplier’s capacity (Grimson & Pyke, 2007). This again suggests the importance of receiving accurate forecasts from the sales department. When deviations from the typical quantities are relayed to the supplier in time, the supplier can take actions to meet the new demand level. At the same time the supply department should also clearly and timely communicate the limitations of the supply chain to the sales department. This is necessary to ensure that demand can be matched by the available supply capacities.

Collaboration is key to achieve S&OP success (Lapide, 2004). However, typically the sales department is customer-facing, while the supply chain department is supplier-facing (Ambrose, 2015). The contrasting focus points can create a tension field that impedes the willingness to collaborate. Lacking a common understanding and low levels of information sharing make it very difficult to achieve the optimal output levels of the organization. The inability to achieve collaboration between different functional groups is believed to be one of the main reasons why so many S&OP initiatives fail (Milliken, 2012; Wallace & Stahl, 2008). According to previous research roughly 30 percent of S&OP initiatives fail to achieve the intended results (Milliken, 2008; Wagner, 2014). The difficulties in achieving cross-functional collaboration are believed to be the biggest obstacle in achieving improved performance.

In recent research by Ambrose (2015), a conceptual performance framework is developed to improve the current knowledge about the relevant factors that contribute to increased performance in the context of S&OP. Eight variables are described that are thought to affect the level of constructive engagement, based on previous research. The variables are a combination of the internal team factors social cohesion and superordinate identity, and the external team factors top management support, centralization, information quality, rewards & incentives, procedural quality, and resources and time.

The objective of this research is to propose a new model of factors that affect constructive engagement in a S&OP context. Accordingly, the following research question is posed:

**What are the factors affecting constructive engagement in a S&OP process?**

With respect to this research question, an integrated model was developed that incorporates and builds on the works in previous research. The research work was initiated with a wide-ranging literature review.
to locate gaps in the current literature, and identify relevant factors enabling constructive engagement. Next, a case study was conducted to evaluate the model in a case organization. This approach was taken in order to provide the context-dependent findings needed for qualitative research.

For the case study, an industry company operating in a high-mix, low-volume manufacturing environment was targeted. During the case study, observations, documentation, questionnaires and interviews were used to gather information.

1.2 Research Scope
The research targets at a S&OP process redesign in a high-mix, low-volume manufacturing environment. This environment is characterized by an extensive product portfolio, low individual product sales numbers, and a large number of suppliers. These characteristics cause a high level of complexity. Furthermore, these departments have conflicting objectives; sales want to have flexibility to meet customer-specific requirements, while the manufacturing department prefers predictability and certainty. The resulting functional conflict obstructs the collaboration that is required to make S&OP work. Figure 3 graphically represent the disconnection between the sales department and the supply chain department that the S&OP process intends to resolve. This research work focuses on the cross-functional constructive engagement that is needed to achieve successful balancing of demand and supply.

![Diagram of Disconnection between Demand and Supply](image)

1.3 Document Structure
In this chapter the topic of this paper is presented, along with the research description and scope. The remainder of this thesis reports is structured as follows. Chapter 2 provides the findings of the literature study. Previous work related to the S&OP process and constructive engagement is identified and discussed. Two relevant previous models are analyzed, and the motivation for a new model is given. Chapter 3 introduces the research design, including the development of the proposed model, and the case study description. In chapter 4 the research model is presented with a separate section for each proposed factor in the model. In chapter 5 the results of quantitative and qualitative analysis are discussed. The findings of the research are integrated, potential threats to validity are discussed, and directions for future work are identified. Finally, chapter 7 presents the conclusion of this thesis research.
2. Background and Related Research

A literature review was conducted over a broad range of prior work to assess the current knowledge regarding S&OP, and target relevant gaps in the literature. The findings are presented in the sub-sections that follow. First, S&OP process related literature is presented. Next, the importance of conducting case studies about the S&OP process is discussed. Among several gaps in the current literature, the one regarding the development of a comprehensive understanding of how S&OP should be implemented was chosen as a starting point for this research work. Constructive engagement was identified as the key factor to achieve performance improvements associated with S&OP. Next, variables affecting the level of constructive engagement are explained using existing model of constructive engagement in a S&OP context, developed by Ambrose (2015), and Olivia & Watson (2011). At the end of this chapter these models are compared, and the motivation for a new model is provided.

2.1 Sales and Operations planning (S&OP)

In today's dynamic economic environment companies are faced with an increasingly competitive market. Globalization, market uncertainty and increasing supply chain complexity raise challenges for coordination of business processes (Laurent Lim et al., 2014). The production of capital goods becomes increasingly more complex and resource-intensive. As companies make use of global sourcing, longer or variable lead times become more common. Therefore, more and more companies are turning their attention to the optimization of the supply chain.

Supply chain management is based on the concept of forming traditionally non-coordinated business units into a unified integrated organizational unit along the supply chain to coordinate the business process effectively form suppliers to the customers (Feng et al., 2013). Sales and operations is a concept related to supply chain management which has gained a lot of recognition over the past decade. A recent study of global manufacturers by Prokopets (2012) shows 70% of the study participants had implemented an S&OP process.

S&OP provides an instrument for both the horizontal alignment of demand and supply plans, and the vertical alignment of business strategy and operational planning. (Feng et al., 2013; Wagner et al., 2014). The general objective is matching the demand and supply in the medium-long time horizon. S&OP serves as a communication and decision making process that addresses volume and product mix and the company’s key resources (Xu et al. 2009). S&OP is a monthly-based tactical planning process, which is led by senior management and is oriented towards the balancing of demand and all the supply capabilities of production, distribution, procurement, and finance to ensure the plans and performance of all business functions are aligned to support the business plan (Ling, 2002; Aberdeen Group, 2004; Bower, 2005).

Aligning business strategy and operational planning is required for successful S&OP. To achieve alignment several coordination mechanisms have to be put in place. Coordination is the process of communication and decision making among a set of actors to achieve common goals (Malone, 1987). In the context of supply chain management, coordination is realized when the decisions are beneficial to the supply chain as a whole (Gupta & Weerawat, 2006). The decisions about production and procurement quantities to
meet demand require coordination among internal business units and external partners (Schneeweiss, 2003).

Although S&OP enjoys growing managerial interest, several issues pose a challenge to the implementation and overall performance. One of the main challenges concerns the interaction between the Sales and Manufacturing departments (Ambrose, 2015). These departments often have different goals and achieve incentives in different ways (Lawrence & Lorsch, 1967; Mello, 2010). The main goals of sales representatives are to grow revenue and be flexible with the customer requirements. This leads to a preference for a wide product variety and sales with a full spectrum of available products (Singh, 2010).

In contrast, manufacturing managers are often evaluated and incented based on the efficiency of the production process. This leads to a preference for a narrow product scope and low inventory levels (Olivia & Watson, 2010; Shapiro, 1977). From a social perspective, sales managers have generally always been involved in the sales and marketing departments, while production plant managers have ascended through production as foremen and production supervisors. The resulting difference in specific knowledge leads to a different way in thinking and communicating, and a difference in culture (Konijnendijk, 1993, Shapiro, 1977).

Further challenges regarding S&OP involve the implementation and application. Although the literature makes the S&OP process appear easy to understand, many organizations face difficulties when trying to achieve the expected benefits (Bower, 2005). The literature only provides limited understanding of how the performance can be improved with the implementation of S&OP (Thomé et al, 2012). These problems indicate that the literature does not currently provide clear guidelines for the companies to follow to achieve a successful S&OP process. Especially methods to facilitate coordination between different functional departments are needed. This is due to the understanding that a well-maintained relationship between different function groups enhances the firm performance (Flynn et al. 2010).

Previous literature reviews on the S&OP process have provided a better understanding and some guidelines for practical use. Thomé et al. (2012) conducted a systematic literature review to offer empirical evidence of the effect of S&OP on firm performance. This review showed there is at least partial evidence that cross-functional planning processes can minimize the negative effect of contradicting performance measures on firm performance. Singhal & Singhal (2007) showed the central role of operations management by linking it with supply chains and other function departments in the organization. Tuomikangas & Kaipia (2014) aimed to synthesize a framework of coordination mechanisms in S&OP with their literature review. This led to identifying six relevant coordination mechanisms for S&OP.

What all previous literature studies have in common is the remark that more empirical research is needed on the topic of S&OP. An especially obvious lack of case studies is described. The information gained from case studies may provide a better framework for the implementation and continuous use of the S&OP process. This may help practitioners in overcoming the previously mentioned challenges. The existing case studies will be briefly discussed in order to find a specific part of the S&OP process where more research may be needed.
Case Studies
In a systematic review, Thomé et al. (2012) found a single case study among 55 articles that are reviewed. The paper by Olivia & Watson (2010) describes a case study of the S&OP process at a global consumer electronics company. This company was characterized by the presence of work groups, and incentives and rewards that were separately set for the different functional groups in the organization. This misalignment led to cross-functional conflicts. The case study was conducted using semi-structured interviews, direct observations of planning and forecast meetings, and by reviewing documents. The company’s goal of implementing S&OP was to achieve functional alignment and improve firm performance. It was hypothesized that S&OP has an intermediate role between the structural determinants of cross-functional alignment and firm performance through the mediating effects of procedural quality, information quality and alignment quality. It was found that achieving alignment in the execution of plans can be more important than informational and procedural quality.

In their literature review, Tuomikangas & Kaipia (2014) reiterate the need for empirical research to complement the existing modeling and simulation studies in the field. Their study reveals three articles (including the one by Olivia & Watson (2010) discussed above) that report on the case studies that were conducted. The study by Ivert & Johnsson (2010) describes the use of advanced planning and scheduling systems (APS) in the S&OP process. The study reports that this combination led to benefits regarding the learning effects, the support of decisions, and the planning efficiency. The third paper by Collin & Lorenzin (2006) focuses on how collaborative planning can increase the agility of supply chains. Their article is of a more descriptive nature, and describes the lessons learned from collaborative planning. It is argued that customers’ demand could be better used by suppliers to achieve more agility and aligning supply chains. Furthermore, they conclude that collaborative applications in information technology can bring more formalization to the planning process.

From the previous literature studies, it can be concluded that there is a need for further empirical research involving the sales and operations planning process. Especially conducting case studies has the potential to provide practitioners valuable information and gain further understanding of S&OP.

Research Gaps
The review of the existing literature involving S&OP uncovers several research gaps, as reported in studies by Tuomikangas & Kaipia (2014) and Thomé et al. (2012). Two key research gaps are selected for this thesis research. These are:

1. The development of a comprehensive understanding of how S&OP should be implemented
2. Limited empirical research (e.g. case studies) involving S&OP.

In the following, we elaborate on these research gaps.

The development of a comprehensive understanding of how S&OP should be implemented
Although the challenges associated with the implementation of S&OP are dealt with widely in practitioner literature, this aspect is almost completely absent from academic literature. Current academic research offers few guidelines how to make optimal use of the capabilities of S&OP (Tuomikangas & Kaipia, 2014). The lack of research on this topic seems odd, given the high implementation costs and high level of
expected benefits. The study by Grimson & Pyke (2007) proposes a framework to assess the S&OP process maturity at an organization. The five integration stages can help managers in determining the current S&OP maturity, and choosing steps to improve to the next stage. In this research a variety of organizations are interviewed, ranging from job-shop production to high-volume commodity production. This research however does not provide guideline for the implementation of the S&OP process. Future research should focus on providing guidelines for managers in the process of implementing a S&OP process.

Limited empirical research involving S&OP
Limited empirical research in the form of case studies about the S&OP process in the current academic literature has been mentioned on several occasions in this thesis. Most of the empirical evidence in previous papers has been gathered using interviews and surveys. The use of a case study offers an in-depth look into the implementation process at an organization. This can provide valuable insight into the lessons and pitfalls of S&OP implementation that can provide guidance for organizations planning to implement the process.

Research gap analysis
The literature study provided two key gaps in the current S&OP related research. First, limited empirical studies through case studies provided the motivation for a research with a case study design. Second, since many companies seem to struggle at the development and early implementation stages, this research focusses on the development of a comprehensive understanding of how S&OP should be implemented. The focus will be on the factors that affect constructive engagement. The next sub-sections elaborate on the role of constructive engagement in a S&OP context.

2.2 Cross functional collaboration
The balancing of demand and supply activities involves and requires input from various functional groups. Sales, marketing, finance, R&D, manufacturing and purchasing are involved, among others. Therefore the S&OP process requires a cross-functional effort (Braunscheidel & Suresh, 2009). The collaboration between the functional groups often proves to be a challenge for organizations. The main reasons for this are the differences in specializations, priorities and incentives, as they often cause conflicts with respect to how supply and demand should be balanced (Shapiro, 1977). The S&OP process requires a high level of collaboration in the Supply Chain (McCarthy & Golicic, 2002). In his research paper Nakano (2009) categorizes the concept of collaboration into three dimensions:

1. Sharing resources
2. Collaborative process operation
3. Collaborative process improvement

Sharing resources means the sharing of standardized information such as forecasts, and data about inventory, production and purchasing. Furthermore, customized information such as operational constrains, resources, and factors of demand fluctuation are used (Nakano, 2009). The collaborative process operation refers to the involvement of forecasts into the planning at the Manufacturing Centers. Deviations between the forecasts and the planning are examined, and plans of action are constructed if
necessary. *Continuous process improvements* are required to stay flexible in the fast-changing global environment. Therefore, organizations must incorporate collaborative process improvement. This means firms have to improve existing processes, eliminate unnecessary processes, and redesign organizational roles and responsibilities.

The research by Nakano (2009) has provided findings that prove the positive effects of collaborative forecasting and planning on the logistics production and performance (as depicted in the model, presented in Figure 4). The logistics production and performance was measured using questionnaires at 65 Japanese manufacturing firms. The performance indicators included logistic costs, order fill rate, and delivery speed. Collaborative forecasting and planning can be done with suppliers, with customers, or internal. Internal collaborative forecasting and planning is the integral part of the S&OP process (and the topic of this thesis). Although Nakano (2009) proves the positive effect of S&OP of the logistics performance, the research does not report how internal collaborative forecasting and planning is achieved.

![Figure 4: Effects of Collaborative forecasting and planning on Logistics Production and Performance (Nakano, 2009)](image)

### 2.3 Constructive Engagement

Successful S&OP requires a great deal of teamwork and cross-functional collaboration (Braunscheidel & Suresh, 2009; Feng et al., 2014; Ambrose, 2015). This means people with different perspectives and functional orientations need to work together to reach a common goal. This combination of collaboration and functional conflict is generally referred to as constructive engagement (Ambrose, 2015; Olivia & Watson, 2011). The model proposed in this thesis integrates and builds on two models proposed in previous work; the *S&OP performance model* by Ambrose (2015), and the *planning process quality model* by Olivia & Watson (2011).

**S&OP Performance model by Ambrose (2015)**

The *S&OP performance framework* by Ambrose (2015) identifies internal team factors, contextual influencers, and environmental factors, and their effects on S&OP performance. The model of this framework is presented in Figure 5. The framework is based on group effectiveness theory and is validated using a large scale survey-based research. Constructive engagement is presented as a central factor in this model, indicating the crucial role it represents to achieve improved S&OP performance (Ambrose, 2015).
Internal Team Factors:
The internal team factors, social cohesion and superordinate identity, are necessary to achieve team chemistry and constructive engagement. These factors define how comfortable people are within the team, and how much they feel part of the team.

Social cohesion can be defined as the strength of interpersonal connections between team members (Hogg, 1992). The presence of social cohesion can stimulate exchange of resources within teams, and thus contribute to improved collaboration (Nakata & Im, 2010).

Superordinate identity measures the cognitive component of the relation a member feels towards the team (Sethi, 2000). It defines the extent to which members are committed to shared goals, and have a significant part in the success or failure of the collective task (Nakata & Im, 2010). Strong presence of superordinate identity can mitigate functional biases and develop a group identity. A lack of superordinate identity can decrease group effectiveness due to lower levels of knowledge sharing.

Contextual Influencers:
The contextual influencers are the external team factors that define the context of the S&OP team within the organization. These factors describe the quality of the process and information, as well as the support of top management and how this translates to the available resources for the team.

Top management support is identified as a critical component for the success of a variety of organizational changes (Li & Ling, 2006). Top management refers to senior level managers, who are involved with formulating the strategy and tactical moves of the organization. Top management support becomes apparent in the appropriate allocation of resources, direct involvement in the process and communication from senior managers.

Information quality defines the degree of appropriateness and usefulness of information sharing for the team members and decision makers (Olivia & Watson, 2011). Information quality can be achieved by stimulating frequent, complete and reliable information sharing between team members (Wallace & Stahl, 2008). High levels of information quality can contribute to the performance of cross-functional collaboration, while low levels can have a negative effect on the outcomes (Li & Lin, 2006).
**Procedural quality** is defined by Olivia & Watson (2011) as “the degree to which a process continuously ensures that the rules of inference used to validate information, and to make decisions within and between functions, are appropriate and sound.” Procedural quality is a structuring mechanism which ensures organizational activities are governed by established rules and procedures (Nakata & Im, 2010).

*Rewards and incentives* refers to the extent to which team members are recognized not just for their operational task, but specifically for their contributions to achieving team-based goals (Ambrose, 2015). Joint rewards are a way of linking a worker’s income to outcomes of cross-functional team work. Aligning rewards and incentives with team goals is often found to be difficult to achieve. The personal contribution towards team success or failure can hardly be quantified, making it difficult for a member to assess the fairness of the reward system. Still, committing team members to develop common goals through aligned incentives is seen as an important factor for achieving collaboration (Xie et al, 2003).

The factor *centralization* refers to the extent to which the power of decision making resides with upper management. Centralized organizations are characterized by the concentration of decision making located at the top level of the organization (Dewar & Werbel, 1979). The consequence of high levels of centralization is low decision making power within the S&OP team itself, meaning decisions always has to be directed to and approved by the top management.

The last external team factor is *resources and time*. Appropriate resources and adequate time are critical variables for achieving successful outcomes of team work (Holland et al., 2000). In S&OP context, resources refer to having access to training and background information about the S&OP process (Ambrose, 2015). Appropriate information quality is another resource that can contribute to reaching team goals, and promoting a common language and understanding. Organizations should recognize the importance of S&OP related tasks and allocate adequate time for members to work on them (Wagner et al., 2013; Menon et al., 1997).

**Environmental factors:**
The variables market turbulence and technology turbulence are factors that are likely to affect the S&OP performance (Ambrose, 2015). This assumption is reflected in the model of S&OP performance by Ambrose (2015), where the two factors are proposed to influence the effect of constructive engagement on S&OP performance.

The factor *market turbulence* describes the degree of change in customer-preferences, and customer group composition (Kohli & Jaworski, 1990). This factor is directed at the stability of the demand-side. Technology turbulence refers to the supply-side stability, and reflects the amount of disturbances in the product generating processes (Kohli & Jaworski, 1990). A simpler definition is provided by Menon et al. (1997) who describe the technological turbulence as the rate of technological change within an industry.

**Constructive Engagement:**
The factor constructive engagement plays a central role in the S&OP performance model by Ambrose (2015). In the literature the term constructive engagement refers to the combination of collaboration and functional conflict (Olivia & Watson, 2011).
**Outcome:**
The outcome of a S&OP process is captured by the factor *S&OP performance* in the model developed by Ambrose (2015). The measurement of S&OP performance in the research by Ambrose (2015) was achieved by using a scale developed by Wagner et al., (2013). In their research, Wagner et al., (2013) define the benefits of S&OP as “a vertically and horizontally aligned set of marketing, development, manufacturing, sourcing, and financial plans that enable the ongoing balancing of supply and demand”. In the research by Ambrose (2015), these S&OP benefits are labelled as the factor *S&OP performance*.

**Planning process quality model by Olivia & Watson (2011)**
The research by Olivia & Watson (2011) reports on a single case study at an organization where cross-functional conflicts are overcome, by making use of a S&OP process. Functional conflicts between department mainly arise from misaligned incentives, which are common in many organization with distinct sales and production functions. A process perspective is taken by Olivia & Watson (2011) to identify the process as a mediator to support different incentives, while maintaining the required S&OP process outcomes. Figure 6 shows the proposed model of planning process quality by Olivia & Watson (2011)

![Figure 6: Planning Process Quality model (Olivia & Watson, 2011)](image)

**Misaligned Incentives**
The incentive landscape in an organization defines the formal mechanisms that are in place to influence the behavior of departments. Holmstrom & Milgrom (1994) make a distinction between high-powered incentives, and low-powered incentives. High-powered incentives are based on measures of performance (e.g. sales commissions), while low-powered incentives are rewards that are received by the employee independent of performance (e.g. fixed salary) (Olivia & Watson, 2011). The goal of the research by Olivia & Watson (2011) was to provide more insight into how a S&OP process is able to achieve improved organizational performance, despite the maintenance of misaligned incentives and orientations between departments.
Open and Transparent Process
During their case study, Olivia & Watson (2011) observed a S&OP process that was open and transparent. Participants were motivated to share the information of their respective departments, and the process enabled each stakeholder to influence the outcomes of the process. By sharing and consolidating all relevant information, stakeholders in the S&OP process were explicitly confronted with their opposing orientations and incentives. This open and transparent process enabled participants to reach alignment, and achieve improved performance. By motivating the participants, and enabling a platform for collaboration and functional conflict, constructive engagement was observed by Olivia & Watson (2011).

Participant’s Engagement
In their model of planning process quality, Olivia & Watson (2011) identify the factor participant’s engagement as a link between perceived benefits for the participant, and the quality of the S&OP process. However, much more frequent in their paper is the term constructive engagement. Constructive engagement is described as the active involvement of all stakeholders in collecting, validating, and adapting information, and guarding outcomes that impact their respective departments. Olivia & Watson (2011) observed the crucial role of constructive engagement in achieving improved process quality, by positively affecting the process attributes information, procedural, and alignment quality.

Quality of S&OP Process
Olivia & Watson (2011) identify three elements of S&OP process quality; information, procedural, and alignment quality. Information quality ensures decision making is enabled, by verifying the appropriateness of the form and content of information. Procedural quality refers to the degree to which information validation and decision making are continuously monitored for integrity. The third process attribute alignment quality refers to the degree to which organizational and functional goals are supported by a process, and that the actions are synchronized. During their case study, Olivia & Watson (2011) observed the positive impact of S&OP process quality on the quality of the S&OP process outcomes.

Quality of S&OP Process Outcomes
In their research, Olivia & Watson (2011) report on the social and performance outcomes of implementing a S&OP process. Performance outcomes included operational measures, such as improved inventory control. While social outcomes included the increased frequency of constructive engagement, including sharing information and aligning operational decision making with the organization goals (Olivia & Watson, 2011). The improved social outcomes indicated the transformation of the participants perceptions.

Participant’s Perceptions
Olivia & Watson (2011) observed changing participant’s perceptions during their case-study. The S&OP process enables stakeholders to share their perspectives, and influence decision making by actively engaging in the S&OP process. Improved perceptions of the S&OP process lead to the improved perceived benefits of participating in the S&OP process, leading to constructive engagement (Olivia & Watson, 2011).
2.4 Analysis of existing constructive engagement models

In the previous section two models are presented that indicate the central role of constructive engagement in a S&OP context. The model of S&OP performance by Ambrose (2015) identifies both internal and external team factors affecting constructive engagement. A positive relation between constructive engagement is proposed, that can be impacted by environmental factors. The planning process quality model by Olivia & Watson (2011) aims attention at the perceptions of S&OP stakeholders. In the model a reinforcing structure is proposed from the S&OP process outcomes back to constructive engagement, flowing through the perceptions of process quality and benefits of participating in the S&OP process. The S&OP process is identified as a mediator that allows for improved performance, while maintaining misaligned incentives between departments.

While both models agree on the crucial role of constructive engagement to achieve performance improvement, some clear distinctions between the models can be made. To start with, the research was conducted in different ways. Ambrose (2015) made use of a questionnaire approach to reach multiple organizations, operating in different fields and industries. Olivia & Watson (2011) made use of a single case study approach, that allowed to make observations and conduct more in-depth interviews with the participants.

The different approaches led to different ways of analyzing and presenting the findings. The findings by Ambrose (2015) are analyzed quantitatively with a statistical approach. This allowed to make more general statement about the findings of the research. The research by Olivia & Watson (2011) was conducted at a single organization, making is harder to make general statement about the findings. Therefore, their model was put together by combining four propositions, based on the findings at the case organization.

The focus of the two models provides different views on the factors affecting constructive engagement in a S&OP context. The model by Ambrose (2015) identifies eight variables that are proposed to have a direct effect on constructive engagement. These factors include both internal and external team factors. A direct positive effect of constructive engagement on S&OP performance is suggested. In the model by Olivia & Watson (2011) several factors are identified identically to the model by Ambrose (2015); constructive engagement, information quality, procedural quality, rewards & incentives, and S&OP process performance. The factor social cohesion proposed by Ambrose (2011) differs from what Olivia & Watson (2011) identify as an open and transparent process. While social cohesion refers to the extent to which people are working together, an open and transparent process refers to the willingness to share information. Centralization is defined by Ambrose (2015) as the amount of decision making residing at the top levels of the organization. This construct is the opposite of what Olivia & Watson (2011) describe as the amount of influence the participants in the S&OP process have on decision making, which is reflected in the factor perceived benefit of participating in the S&OP process. Superordinate identity is similar, but extends simply seeing benefits in participation, by feeling like a full member of the S&OP team. Two external team factors are identified in the model by Ambrose (2015) and are absent in the model by Olivia & Watson (2011), namely top management support and resources & time. The factor alignment quality refers to the extent to which organizational and functional goals are supported by the S&OP process, and that the actions are synchronized. This factor is present in the model by Olivia & Watson (2011), but is not
a part of the model by Ambrose (2015). Finally, Olivia & Watson (2011) propose a cycle of continuous improvement in their model. A reinforcing structure is presented, going from S&OP process outcome quality back to constructive engagement, flowing through participant’s perceptions. A relation between S&OP performance and constructive engagement is absent in the model by Ambrose (2015).

The similarities and differences between these two models of constructive engagement in a S&OP context provide the motivation for a new model. The combination of these models into an integrated model can add to the literature by building on findings from previous work, and validating the new model with a case study approach. The research design that is used for this research is explained in the following chapter.

3. Research Design

This chapter describes the research design used during the master thesis study. The research process is presented is Figure 7. A literature study is conducted to gain understanding of the S&OP process in general, as well as the role of constructive engagement in a S&OP context. The development of the proposed model integrated the findings of previous research, and the case study conducted at an industry organization. During the case study exploratory interviews were held with members of the S&OP team at the case study organization. These members also participated by filling out questionnaires to assess the perceived levels of the factors affecting constructive engagement. During the final interviews the proposed model was validated with members of the case study organization. The factors and relations in the proposed model are analyzed both quantitatively and qualitatively.

![Figure 7: Research Design](image)

3.1 Literature Review

Literature has been gathered from books and research articles from academic journals. The main sources to find and retrieve previous work were the online Google Scholar search engine, the TU Eindhoven university library, and the TU Eindhoven database of academic journals and books, and research reports. During the first part of the literature review previous work on the S&OP process in general was analyzed. This led to the identification of a need for the development of a comprehensive understanding of how S&OP should be implemented. Due to the highly social nature of the S&OP process, constructive engagement was identified as a crucial factor for the success of a S&OP process implementation. Therefore, during the final part of the literature review, the focus was on literature covering the role of constructive engagement in a S&OP context. This led to the identification of the work by Ambrose (2015), and Olivia & Watson (2011). The model proposed in this thesis incorporates and builds on findings from this previous work.


3.2 Development of Proposed Model

Van Aken et al. (2007) identify two distinct approaches to qualitative data analysis; the grounded theory approach, and the template approach. The grounded theory develops theory out of raw qualitative data in a structured way. It presents a structured approach for the exploration of new and unfamiliar territory (Van Aken et al., 2007). The grounded theory approach is aimed at the developing concepts to represent a particular aspect of reality, and finding the relationships between these concepts. Coding is the main tool to develop the concepts. Since concepts are developed during the research, the grounded theory approach does not rely on much theoretical pre-understanding (Van Aken et al., 2007).

In contract to the grounded theory approach, the template approach does rely on existing concepts and theories (Van Aken et al., 2007). Whereas the grounded theory approach uses coding to develop new concepts, the template approach uses existing codes. The use of existing codes enables the researcher to display the data from interviews and questionnaires in a structured way. The systematics display of data enables a structured and valid analysis (Van Aken et al., 2007).

This research study applied the template approach, where the PhD dissertation by Scott C. Ambrose (2015) functioned as the template. Three elements from his paper were used for this research:

- The S&OP performance model (Figure 5)
- The developed questionnaire (Appendix 3 – Questionnaire)
- The findings section from the paper (Appendix 2 – Ambrose (2015) Research Summary)

The template approach uses existing codes. For this thesis research the codes were the variables affecting constructive engagement, extracted from the S&OP performance framework by Ambrose (2015). These variables have been explained in chapter 2.3. The reliance on existing codes improved the validity of this research, since the codes are based on proven concepts. The grounded theory approach was used in the Ambrose paper (2015) to develop the S&OP performance model.

The concepts used in the Ambrose paper (2015) are mostly based on existing literature that includes the applicable questionnaire items with questions and Likert scales. Since most of the concepts are originally developed for new product development teams, Ambrose (2015) had to make small changes to the wording of some questionnaire items. A summary of the modifications and the reliability of the adapted and newly developed scales is given in appendix 4. The questionnaires enabled comparison between respondents’ perceptions regarding variables of constructive engagement.

The final element of the Ambrose paper that was used for this research was the findings section. Whereas this research used observations, questionnaires and interviews to triangulate the findings, Ambrose (2015) strictly used the questionnaires. This approach made it possible to gather a large pool of respondents. A total of 101 questionnaires was used to draw the conclusions about the relationships between the concepts in the proposed S&OP performance mode (Ambrose, 2015). The case study design is time consuming to a high degree, making it impossible to access such a large number of respondents. Furthermore, this single case research only represents the findings at one company, which leads to
limitations regarding the generalizability of the findings. By comparing the rich and context-dependent findings of the single case study to the findings of the Ambrose research (2015) new insights were found. In fact, Ambrose himself proposed in-depth interviews and case study observations of S&OP teams for future research (Ambrose, 2015). Validating the findings of the Ambrose research (2015) is suggested using a study in a field setting, where perceptions can be captured from entire S&OP teams.

Selection of Factors in Proposed Model
In this subsection the selection of factors for the proposed model is explained. The proposed model includes factors affecting constructive engagement, and uses the S&OP performance model by Ambrose (2015) as a template. All factors proposed by Ambrose (2015) and Olivia & Watson (2011) are considered, and are either included, excluded or integrated in the model proposed in this thesis. The complete research model, including suggested effects, is presented in chapter 4.

Included factors
In Table 1 the factors included in the proposed model are presented. All nine included factors are present in the S&OP performance model by Ambrose (2015), and five factors are included in the planning process quality model by Olivia & Watson (2011).

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Social Cohesion</td>
<td>Present in model:</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Superordinate Identity</td>
<td>Present in model:</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Top Management Support</td>
<td>Present in model:</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Information Quality</td>
<td>Present in model:</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Procedural Quality</td>
<td>Present in model:</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Rewards &amp; Incentives</td>
<td>Present in model:</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Resources &amp; Time</td>
<td>Present in model:</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Constructive Engagement</td>
<td>Present in model:</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>S&amp;OP Performance</td>
<td>Present in model:</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Excluded factors
The factors that are excluded in the proposed model are presented in Table 2. The factors market turbulence and technological turbulence are proposed in the S&OP performance model by Ambrose (2015). These factors are excluded, as they do not directly affect constructive engagement. In the quantitative research by Ambrose (2015) these factors had the lowest average variance extracted. High levels of market turbulence were found to amplify the importance of constructive engagement, while technological turbulence was not found to moderate the impact of constructive engagement on S&OP performance. From a managerial perspective these factors could be considered fixed in a short to medium horizon, while the factors included in the proposed model can be influenced through managerial efforts. Alignment quality is identified by Olivia & Watson (2011) as an indicator of process quality, and refers to the extent to which the S&OP process supports the organizational and functional goals. This factors is not included as it is not part of the used template, based on the factors identified by Ambrose (2015).
### Table 2: Excluded Factors

<table>
<thead>
<tr>
<th>Excluded Factors</th>
<th>Present in Model:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ambrose (2015)</td>
</tr>
<tr>
<td></td>
<td>Olivia &amp; Watson (2011)</td>
</tr>
<tr>
<td><strong>Market Turbulence</strong></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>Technological Turbulence</strong></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>Alignment Quality</strong></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Integrated factors

In Table 3 the factors that are not explicitly included, but integrated in the proposed model are presented. These factors are identified in the planning process quality model by Olivia & Watson (2011), which incorporates the perceptions of S&OP stakeholders.

Open and transparent process refers to the level of comfort people have in working together and sharing information. This factor is integrated in the factor social cohesion, which is included in the proposed model and holds a near identical meaning.

The factors perceptions of S&OP process quality and perceived benefit of participating in the S&OP process are not identified in the S&OP performance model by Ambrose (2015). These two factors reflect the reinforcing structure in the model by Olivia & Watson (2011) from S&OP performance back to constructive engagement. This reinforcing structure is absent in the model by Ambrose (2015), but is present in the model proposed in this thesis by integrating these two factors in rewards & incentives. This is explained in more detail in chapter 4.

### Table 3: Integrated Factors

<table>
<thead>
<tr>
<th>Integrated Factors</th>
<th>Present in Model:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ambrose (2015)</td>
</tr>
<tr>
<td></td>
<td>Olivia &amp; Watson (2011)</td>
</tr>
<tr>
<td><strong>Open and Transparent Process</strong></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Perception of S&amp;OP Process Quality</strong></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Perceived Benefit of Participating in the S&amp;OP Process</strong></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>
3.3 Case Study

For this research a single case study design was used. The motivation for this research design, along with the benefits and drawbacks of this design is presented in the following. A single case study design is defined as an empirical research that investigates a phenomenon in depth and within its real-life context (Yin, 1989). This type of research design is able to provide a high level of detail and understanding of the context. This makes this research especially interesting for the S&OP process, which has not been the topic of an extensive number of previous work incorporating a case study design.

Case study organization

The case study organization for this research is a capital goods manufacturing firm. Four reasons are presented that make this organization a viable representative case for a single case study (Yin, 1989). First, the organization experiences challenges in achieving collaboration between the sales department and the manufacturing center, which are quite common across a wide range of industries with a sales force driven demand (Shapiro, 1997). In addition the organization operates in a high-mix, low volume manufacturing environment. This characteristic is of great importance to the business strategy, since making machines to stock can drive up inventory costs due to low demand frequency and a large product portfolio. Third, the project offers the opportunity to follow the implementation of S&OP from a very early stage. The design is still developing, and the decision making process can be witnessed firsthand. Finally, the project management and change management that is required for a project of this scale, which will bring considerable changes. The first reason indicates a representative case, while the other reasons indicate unique circumstances which have not been extensively described in previous research. These reasons suggest the appropriateness of using a single-case study research design.

In the section above several statement are made to argue the appropriateness of the selected organization for conducting a case study. However, several factors provide arguments to question the appropriateness of the selected case organization. First, the S&OP was in the early stages of working with a S&OP process. The learning curve that can be expected with any new way of working could influence the perceptions of people involved in the process. Closely related, by taking the questionnaires during these early stages respondents may answer based on expectations, rather than their actual experiences.

Besides the strengths and flaws regarding the appropriateness of the case organization, practical reasons played an important role in the selection of the case organization. A potential case organization had to work with a S&OP process, be willing to cooperate, and allow the research to take place within their organization. These practical reasons played an important role in the selection of a case organization. Given the limited time available for this research, the choice was made for a single case study design.

Capital goods manufacturers are increasingly exposed to market changes which drastically increase the complexity of operations. Changes in the market are a product of the globalization of organizations, and the resulting increase in competition. Improved global logistics and communication have increased the customers’ willingness to look for the best deal on a global scale. Furthermore, the larger pool of competitors has led to higher levels of price sensitivity and demand for customer-specific requirements.
Customers are looking for a high-quality product customized to their needs, against the lowest possible price and with the shortest possible delivery time. The need for highly customer-specific products leads to capital goods manufacturers working in a high-mix, low-volume manufacturing environment. This type of environment is defined by manufacturers with a large product portfolio, with relatively low sales numbers per product type. Figure 8 shows how these market characteristics give rise to high level operational complexity,

The high complexity associated with the market of high-mix, low-volume manufacturers gives rise to information asymmetry, where an optimal solution is might not be found, due to unwillingness or inability to completely share information. Additionally, Information asymmetry is caused by the opposing functional orientations, where the sales department is customer-facing; the supply chain department is supplier-facing (Kraiselburd & Watson, 2007). A cross-functional effort is required to minimize mismatches, due to complexity information asymmetry, and create operational value (Lawrence & Lorsch, 1967). However, differences in specialization are notorious for generating conflicts within organizations (Shapiro, 1977).

The case study organization decided to implement a S&OP process to facilitate the cross-functional alignment and decision making. Increased information sharing initiatives include improved forecasting methods, new meetings structures and a clear set of production constraints. A high-level representation of the S&OP process at the case organization is presented in Figure 9. During the demand planning phase separate sales forecasts are unified in an unconstrained demand plan. The supply required to meet this plan is investigated during the supply planning phase. In this phase the constraints of the supply chain and the production sites are taken into consideration. In the demand supply balancing phase several scenarios are created. A scenario is analyzed on customer impact, and financial aspects. One or more scenarios are presented to the executive board. In the executive S&OP meeting the proposed scenarios is reviewed and the final plan is decided. After this meeting the S&OP plan is executed. The complete S&OP cycle as presented in Figure 9 takes four weeks.
Single case study design
A similar single case study design about S&OP is used by Olivia & Watson (2010). This design can be used to discover which variables, skills or behavior contribute to the success or failure of a process, and has the potential to provide new insights. Data can gathered during a case study through interviews and questionnaires. In this thesis, a case study is conducted during the implementation of a new S&OP process at the case organization. This has not been investigated in a S&OP context to the best of the author’s knowledge. This makes a single case study design a valid research method. Evidence from case studies may come from various sources; documents, interviews, observations, and questionnaires (Yin, 1989). In this thesis four sources provided the basis of information, and the input for answering the research questions:
• Documentation
• Observations
• Interviews
• Questionnaires

During the case study, documentation from the case study organization provided background information about the company, and the departments and sectors that are affected by the new S&OP process design. Documentation included existing process charts, job descriptions, and information booklets that were distributed before and during the development and implementation of the new S&OP process.

Observations were made during the case study, which lasted seven months at the case organization. The researcher was able to attend meetings and presentations at the case organization. These included both operational meetings, and meetings related to the S&OP process redesign.

During the single case study in-depth interviews provided the most valuable source of rich information. In order to achieve reliability and prevent the respondent bias, organization members from different functions and department were targeted, in collaboration with the S&OP project team at the case study organization. During the case study, 10 key informants were interviewed. The key informants were members of the S&OP Project team, Sales, and Operations departments. All participants were part of the S&OP process redesign initiative at the case organization, which, in the time of performing the case study in 2015 was in the process of developing and implementing the S&OP process.

Exploratory Interviews
During the case study, semi-structured interviews were conducted with the S&OP team members at the research organization. The goal of the interviews was an increased understanding of the case study organization, and helping with the selection of key informants for the final interviews. Furthermore, the exploratory interviews were used to find out the motivation for the implementation of a S&OP process, including the benefits, proposed changes and challenges associated with the current process. The selected key informants were asked to participate in the answering of questionnaires.

Questionnaires
The questionnaire template was taken from the Ambrose (2015) research to increase the validity of the answers. The answers from the questionnaire were combined with the findings from the exploratory interviews and observations during the case study. These findings are analyzed graphically and numerically, and are presented in combination with representative quotes from key informants. This provided an analysis that is rich in information and allows for a better understanding of the context. The analysis of the results was presented to members of the S&OP project team at the case study organization.
Final Interviews
After the development of the proposed model, semi-structured interviews were conducted with the S&OP team members at the research organization to validate the model. The goal of these interviews was to assess the usefulness of the model for practitioners, and provided a test for the recognition of results criteria from Van Aken et al. (2007). In the final interviews with members of the S&OP project team the recommendations that follow from the proposed model were presented and discussed. This provided insight into the practical use of the proposed model.

Ethical aspects
During the case study ethical aspects were taken into account. All references to the case study organization and the respondents are reported in an anonymous manner. All participation in the research was on a voluntary basis. Respondent were given the opportunity to review their answers from the questionnaire and interviews. Finally, permission was asked for publishing the findings.

3.4 Analysis of the Findings
The research method includes the combination of quantitative and qualitative data, as proposed by Rossman & Wilson (1984,1991). They advocate using this method for three broad reasons; to enable confirmation or corroboration of each other via triangulation, to provide new insights by exploring new ways of thinking, or to develop elaborate analysis which provides richer detail (Miles & Huberman, 1994).

Quantitative Analysis
The goal of the used research design was to capture the key informant perceptions of the S&OP process and the factors in the proposed model. The perceptions were measured using questionnaires with scales that are adopted from team effectiveness research, and adapted for and validated in a S&OP context by previous research (Ambrose, 2015).

The model proposed in chapter 4, with the hypothesized relations was tested using partial least squares structural equation modeling (PLS-SEM). This method has been used in previous S&OP related research (Hadaya & Cassivi, 2007; Ambrose, 2015). PLS-SEM serves as an especially relevant method for this research, as it can serve as an acceptable analysis method for exploratory research with a small sample size (Hair, Ringle & Sarstedt, 2011). However, in this case study the sample size may be too limited, causing limitations that will be further explained in the discussion section. Hair et al. (2011) advise a sample size for PLS-SEM exceeding ten times the maximum number of paths going into one latent variable. In this research, six paths go into the variable constructive engagement, which would require a minimum sample size of 60 respondents. In this research the sample size is significantly smaller. As a result of the small sample size, questions from the questionnaire had to be removed from the data set. The sample size for estimating the PLS path model had to exceed the maximum number of indicators in a variable. Since the sample size was ten participants, a variable could not contain more than 9 questions. To satisfy this constraint one question was removed from the constructive engagement variable, and three questions were removed for the S&OP performance variable. In the discussions section this will be further explained. The software used for this the analysis part of this research is SMART-PLS version 3.2.3 (Ringle, Wende & Becker, 2016).
Qualitative Analysis

The informants of a case study research are identified by Miles & Huberman (1994) as the most logical sources of corroboration. The implied accumulated knowledge of people, process and products makes informants at the research organization a practical and viable judge to evaluate major findings of a study (Denzin, 1978). In this thesis research the technique presented by Miles & Huberman (1994) was used. With this technique the case study participants were presented with a summary of the findings, and were asked to evaluate the accuracy of the proposed model of constructive engagement. The two members of the S&OP Project team who took part in the S&OP process redesign initiative were selected to validate the proposed model, and indicate the usefulness of the model for a future S&OP process redesign initiative. These two members were selected for their experience with using conceptual models for process redesigns.

4. Research Model

Figure 10 depicts the research model that is developed. In the following, the concept of constructive engagement and the factors of the model are described in more detail. In introducing the factors, the findings from previous research are presented to provide the motivation for the included factors and the respective effects on constructive engagement.

4.1 Constructive Engagement

In the literature the term constructive engagement refers to the combination of collaboration and functional conflict (Olivia & Watson, 2011). Constructive engagement plays a central role in both the proposed models of Olivia & Watson (2011) and Ambrose (2015). This choice makes sense, as one of the core propositions of the S&OP process is achieving formalized collaboration between the functions that manage supply and demand (Wallace & Stahl, 2008).
Constructive engagement - Collaboration
Once sales and operations recognize and embrace their shared responsibilities, performance can be improved through collaboration (Alexander, 2013; Wallace & Stahl, 2008). Collaboration is facilitated through the recurrence of one or more S&OP meetings per plan cycle, with the goal to achieve overall alignment and reach consensus on the demand and supply planning (Stahl, 2010). Besides the formal forms of collaboration, research also indicates the need for informal forms of collaboration (McCormack & Lockamy, 2005). In fact, high levels of informal collaboration are suggested as preliminary indicators of a S&OP process done well (Olivia & Watson, 2011). True collaboration goes beyond the mere sharing of information, and depends on the workers’ ability to build trust and relationship, and learn from each other’s expertise (Ellinger et al., 2006).

Constructive engagement - Functional Conflict
Given their different organizational orientations and scope of responsibilities, conflicts are inherent when sales and operations collaborate (Shapiro, 1977). While achieving cross-functional collaboration is a core goal of the S&OP process, this does not an implied absence of conflict (Ambrose, 2015). In fact, the S&OP offers a forum where presenting different opinions is encouraged. The term functional conflict refers to the belief that different functions will always experience some degree of disagreement, but that disputes can always be resolved in a friendly or even constructive way (Morgan & Hunt, 1994). Open dialogue and open conflict resolutions are mentioned as indicators of functional conflict (Mello, 2010; Stahl & Wallace, 2012).

4.2 Social Cohesion
The first internal team factor is social cohesion, and concerns the extent to which the members of the S&OP team maintain collegiality and enjoy working together. Previous research has identified the positive effects interpersonal social ties have on exchanges within team (Cohen & Bailey, 1997; Nakata & Im, 2010). Although social cohesion has not been studied extensively in an S&OP context, it has been identified as an important factor in facilitating communications between different functional groups within new product development team (Ambrose, 2015; Moenaert et al., 1994). Dougherty (1992) states the positive emotions associated with social cohesion are helpful in overcoming the negative stereotypes that preserve functional silos. Being able to see the value in different functional perspectives is believed to be a necessity for constructive engagement, given the cross-functional nature of S&OP teams (Ambrose, 2015). However, high levels of social cohesion can actually hinder the quality of the process. Sethi et al. (2001) found social cohesion beyond moderate levels can hamper the innovativeness of new product development teams. More generalized, Souder (1998) suggest team potency is lost the moment people become too comfortable around each other and the edges are lost. Groupthink occurs when the strong desire for conformity is paired with insufficient investigation of alternatives (Janis, 1982). This physiological phenomenon causes the loss of creativity and impairs critical decision making (Janis, 1982; Sethi et al., 2001).

In the quantitative research by Ambrose (2015) an inverted-U association between social cohesion and constructive engagement was proposed. This type of relation indicates increased levels of social cohesion lead to a higher level of constructive engagement, but after a certain point the positive relation halts and decreases. This proposition is in line with the findings in the literature that suggest moderate levels of social cohesion are desired, but high levels can stifle critical dialogue and lead to decreased creativity and even groupthink (Janis, 1982; Sethi et al., 2001). Contrary to these expectation, findings of the quantitative research by Ambrose (2015) suggest high levels of social cohesion aid, not hinder, the functional conflict aspect of constructive engagement. This significant relation is in line with findings from a new product development study, where social cohesion is suggested to positively affect performance in join planning
and problem solving (Nakata & Im, 2010). This provides the motivation for the first included factor and effect in the research model:

**Proposed factor and effect:** *Social cohesion,* which has a direct positive effect on constructive engagement.

### 4.3 Superordinate identity

The second internal team factor is *superordinate identity,* and concerns the cognitive relation a member feels towards the team (Sethi, 2000). It defines the extent to which members are committed to shared goals, and have a significant part in the success or failure of the collective task (Nakata & Im, 2010). Superordinate identity has received little research in an S&OP context (Ambrose, 2015). However, previous research suggests superordinate identity plays a key role in innovativeness (Sethi et al., 2001), and cross-functional integration (Nakata & Im, 2010) in similar multi-functional teams. Despite the apparent advantages of superordinate identity, existence of functional bias can prove it difficult to form a group identity for S&OP teams (Alexander, 2013; Wallace & Stahl, 2008). Difficulties especially tend to exist when departments fight over scarce organizational resources (Mello & Stahl, 2011). Since S&OP teams are expected to persist indefinitely, achieving superordinate identity despite functional differences is suggested to be especially relevant in an S&OP context (Ambrose, 2015).

In the quantitative research by Ambrose (2015) a positive relation between superordinate identity and constructive engagement is suggested. The findings confirmed a significant, positive effect on cross-functional engagement. These findings are consistent with group effectiveness literature (Nakata & Im, 2010), and suggest members that value their membership and are committed to shared goals are more likely to constructively engage in S&OP teams (Ambrose, 2015). This leads to the inclusion of the following factor and effect in the research model:

**Proposed factor and effect:** *Superordinate identity,* which has a direct positive effect on constructive engagement.

### 4.4 Top Management Support

The first external team factor is *top management support.* Top management refers to senior level managers, who are involved with formulating the strategy and tactical moves of the organization. Some researchers view the support of senior management as the single most critical driver of success for any significant organizational change (Balsmeier & Voisin, 1996; Li & Lin, 2006). Furthermore, top management support is identified as a prerequisite for group effectiveness (Cohen & Bailey, 1997), and cross-functional collaboration (Wong, 2012). In an S&OP context, sustained top management support is referred to as the single most important element required for a successful S&OP process by leading consultants (Boyer, 2009; Grimson & Pyke, 2007; Milliken, 2008; Wallace & Stahl, 2008).

In the quantitative research by Ambrose (2015) a positive relation between top management support and constructive engagement is suggested. Contrary to expectations based on the identification in previous research of top management support as a critical success factor, a non-significant negative effect on constructive engagement was found by Ambrose (2015). The results from the quantitative research seem to indicate top management does not directly affect constructive engagement, or S&OP performance. However, Ambrose (2015) argues the timing of top management support should be taken into consideration. The respondents in the research by Ambrose (2015) had an average of 8 years of experience in working with a S&OP process, and none of the respondents had less than 6 months of experience. Furthermore, Ambrose (2015) explains the crucial role of top management support during
the setting up of the initial S&OP process. This provides the motivation for the inclusion of the following factors and effect in the proposed model:

**Proposed factor and effect:** *Top management support*, which has a direct positive effect on constructive engagement.

### 4.5 Centralization

The second external team factor is *centralization*, and refers to the extent to which the power of decision making resides with upper management. Centralized organizations are characterized by the concentration of decision making located at the top level of the organization (Dewar & Werbel, 1979). High levels of centralization have been found to obstruct the fair exchange of information, and constructive functional conflict (Menon et al., 1997). Furthermore, low autonomy negatively affects group motivation and the ability to generate aligned decision making (Trent & Monczka, 1994). On the opposite, empowerment and increased autonomy are found to be decisive for successful teams (Holland et al., 2000). Research by Guenter & Grove (2012) determined employees are more willing to participate in collaborative planning, when they perceive their roles as important to the outcomes. S&OP literature identifies decentralization of decision making as a key success factor for the S&OP process (Lapide, 2004).

In the quantitative research by Ambrose (2015) a negative relation between centralization and constructive engagement is proposed. The findings indeed showed a negative relation approaching significance, meaning high levels of centralization are likely to have a negative impact on constructive engagement. These findings lead to the following factor and effect included in the proposed model:

**Proposed factor and effect:** *Centralization*, which has a direct negative effect on constructive engagement.

### 4.6 Information Quality

The process quality factor *information quality* defines the degree of appropriateness and usefulness of information sharing for the team members and decision makers (Olivia & Watson, 2011). Compared to internal team factors, information sharing and quality has received far more attention in S&OP literature and research (Bower & Fossella, 2013; McCormack & Lockamy, 2005; Olivia & Watson, 2011). The sharing of information to and among team members is considered a prerequisite for effective group collaboration (Hackman, 1990). However, little value is created when the information is of low quality (Olivia & Watson, 2011). In particular, the accuracy of sales forecasts is frequently mentioned as one of the key attributes of S&OP performance (Mello & Stahl, 2011; Stahl & Wallace, 2012). Olivia & Watson (2011) witnessed the fostering of constructive engagement through information sharing in their qualitative case study.

In the quantitative research by Ambrose (2015) a positive relation between information quality and constructive engagement is assumed. The findings did not support this relation. However, further testing revealed a direct positive relationship of information quality and S&OP performance, but it does not flow through constructive engagement. This finding is in agreement with the proposed effect of information quality on the S&OP process quality as suggested by Oliva & Watson (2011). Therefore the following factor and effect are proposed:

**Proposed factor and effect:** *Information quality*, which is directly positively affected by constructive engagement, and has a direct positive effect on S&OP performance.
4.7 Procedural Quality

The process quality factor *procedural quality* refers to the extent to which a structured and formalized approach is taken to collaborative work. A structured approach is identified as an important predictor of group effectiveness (Hackman, 1987). Furthermore, support was found for procedural quality as a supporting factor for cross-functional integration (Nakata & Im, 2010). Procedural quality has received considerable attention in S&OP literature (Ambrose, 2015). Examples are the descriptions of the various stages of maturity of the S&OP process (Grimson & Pyke, 2007; Lapide; 2005; Muzumdar & Fontanella, 2006; Wagner et al., 2013). However, little validation of the role and importance of this attribute has been provided (Ambrose, 2015). In their single organization case study research Olivia & Watson (2011) propose the attribute procedural quality as a critical determinant of S&OP process outcome quality.

In the quantitative research by Ambrose (2015) a positive relation between procedural quality and constructive engagement is proposed. A significant relation was not found, contrary to the research’s expectations given the frequent occurrence in S&OP literature (Ambrose, 2015; Oliva & Watson, 2011). However, a direct association between procedural quality and S&OP performance was supported (Ambrose, 2015). These findings are in accordance with the findings of Olivia & Watson (2011) who propose constructive engagement can actually positively impact the procedural quality, not the other way around. These findings are analogous to the findings of informational quality. This leads to the following proposed factor and effect included in the research model:

**Proposed factor and effect:** *Procedural quality*, which is directly positively affected by constructive engagement, and has a direct positive effect on S&OP performance.

4.8 Rewards & Incentives

The factor *rewards and incentives* refers to the extent to which team members are recognized not just for their operational task, but specifically for their contributions to achieving team-based goals (Ambrose, 2015). Joint rewards are a way of linking a worker’s income to outcomes of cross-functional team work. Aligning rewards and incentives is a core proposition of group effectiveness theory (Hackman et al., 2000). The underlying assumption is that joint rewards enlarge the perceived level of interdependence (Chimhanzi, 2004). Ambrose (2015) notes members of the S&OP team only devoted a fraction of their time to the actual process, and thus the priority setting may be difficult if no team-based incentives are in place. While some leading S&OP consultants identify team-based rewards as a sign of S&OP process maturity (Wagner et al., 2013), others indicate the difficulties of changing reward systems to align with S&OP (Grimson & Pyke, 2007). Besides, Olivia & Watson (2011) found in their single firm qualitative cases study that constructive engagement could be achieved even when rewards and incentives were not aligned with S&OP objectives. In fact, the lack of alignment could even be identified as fuel for constructive engagement, with functional conflict in particular (Olivia & Watson, 2011).

In the quantitative research by Ambrose (2015) a positive relation between rewards and incentives and constructive engagement is proposed. The findings from the research identified having team-based rewards and incentives as the single most crucial contextual influencer of constructive engagement within S&OP teams (Ambrose, 2015). Due to this, the following factor and effect are proposed:

**Proposed factor and effect:** *Rewards and incentives*, which has a direct positive effect on constructive engagement.
4.9 Resources & Time

*Resources and time* is the last external team factor. Appropriate resources and adequate time are critical factors for achieving successful outcomes of team work (Holland et al., 2000). In S&OP context, resources refer to having access to training and background information about the S&OP process (Ambrose, 2015). In organizations where time is scarce due to overwhelming responsibilities within the department, S&OP can be viewed as a low priority distraction (Stahl, 2010). The completion of short term task is deemed more urgent and easy to grasp than the long horizon of the S&OP process (Mansfield, 2012). This can lead to the structural negligence of S&OP meetings, or failure to properly prepare (Boyer, 2009). Practitioner literature explicitly mentions structural meetings as a key success factor for S&OP (Lapide, 2004). Another underappreciated aspect is the training of teams within an S&OP context (Ambrose, 2015), despite the suggested improvements in effective collaboration (Donnellon, 1993). One last aspect of resources is the availability of suitable IT facilities. Although general agreement states that sophisticated IT is not a necessity for initial success (Grimson & Pyke, 2007; Wallace & Stahl, 2008), research indicated that technology can improve the efficiency of information sharing and thus improve facilitate constructive engagement (Olivia & Watson, 2011; Wallace & Stahl, 2008).

In the quantitative research by Ambrose (2015) a positive relation between resources and time allocated to the S&OP process, and constructive engagement of the S&OP team. The findings did not support this relation with significance. It was assumed that factors such as developing superordinate identity and aligning rewards and incentives had a bigger impact on constructive engagement than the availability of resources and time. However, Ambrose (2015) argues that the availability of adequate resources and time can play an important role in the initial stages of S&OP implementation. Therefore the choice is made to include the factor resources and time in the model. This leads to the following proposed factor and effect:

**Proposed factor and effect:** Resources and time, which has a direct positive effect constructive engagement.

4.10 S&OP Performance

*Constructive engagement* is presumed to lead to higher levels of commitments and increase willingness to implement the plans resulting from the S&OP process (Olivia & Watson, 2011). Sustained constructive engagement is identified by Ambrose (2015) as a critical factors for the success of the S&OP initiative. Ambrose (2015) defines the following formal definition, which includes aspects of collaboration and functional conflict:

“Constructive engagement is the extent to which S&OP team members proactively collaborate, including voicing and defending their respective interpretations. Having this level of engagement is viewed as the linchpin that connects team and contextual influences to the desirable outcome of S&OP performance.”

Although empirical research on S&OP performance is scarce, descriptions and indicators of a well-functioning S&OP can be found in previous research (Ambrose, 2015). Reduced finished goods inventory is mentioned (Dougherty & Gray, 2013), as well as increased forecast accuracy, minimized supply chain disruption, improved return on assets, and increased customer satisfaction (Wagner et al., 2013). In their research Olivia & Watson (2011) propose a positive relation between constructive engagement and the quality of the S&OP process outcomes, flowing through the quality of the S&OP process, including information quality and procedural quality. Therefore, the following factor and effect is proposed for the research model:

**Proposed factor and effect:** S&OP performance, which is indirectly and positively affected by constructive engagement, flowing through Procedural Quality and Information Quality.
Furthermore, a reinforcing structure is included in the proposed model to measure the effect of S&OP performance on constructive engagement. Previous work has indicated how positive process outcomes can lead to increased constructive engagement (Keating et al., 1999; Shiba et al., 1990). In the planning process quality model by Olivia & Watson (2011), the quality of the S&OP process outcomes is suggested to affect the perceptions of the S&OP team members, which in turn are suggested to have a direct positive effect on constructive engagement. Ambrose (2015) defines the factor rewards and incentives as the extent to which members of a S&OP team receive rewards and incentives based on team-based S&OP goals and objectives. This suggests the factor S&OP performance can affect the factor rewards and incentives, which in turn is believed to increase constructive engagement (Ambrose, 2015; Olivia & Watson, 2011). Hackman et al. (2000) identify aligning rewards and incentives with team-related goals as a core proposition in group effectiveness. People tend to pursue behavior that is rewarded, and the same holds for groups (Glaser & Klaus, 1966). This line of thought is confirmed by scholars who acknowledge a growing trend of rewarding workers based on team-based goals, in addition to individual goals. (Arndt et al., 2011; Bamberger & Levi, 2009).

However, previous work does not always provide evidence a relation between incentives and the intended performance enhancements is present. A recent study by Driedonks et al. (2013) suggests team-based rewards positively affects group effort, but a positive effect on overall effectiveness was not supported. In a different study, shared rewards systems were found to improve information sharing, but not the connectedness between departments (Chimhanzi, 2004). Furthermore, Grimson & Pyke (2007) acknowledge the difficulty that is often encountered when trying to change reward structures to align with team-based S&OP goals.

Still, the rewarding of S&OP team members to achieve team-based goals is advocated (Singh, 2010), and is identified as a sign of S&OP process maturity (Wagner et al., 2013). Ambrose (2015) describes an example how a sales department could be incented to not only care about sales and revenue, but also about the associated cost, such as inventory and scrap costs. This example illustrates how incentives aim to increase collaboration. In the work by Olivia & Watson (2011) the effect of incentives of functional conflict is described. It can be concluded more research is needed to determine the effect of incentives of the relation between S&OP performance and constructive engagement. To measure if S&OP performance affects constructive engagement based on the incentive landscape, the following factor and effect are proposed in the research model:

**Proposed factor and effect:** S&OP performance, which has an indirect positive effect on constructive engagement, flowing through rewards & incentives.
5. Results and Discussion

In this chapter, the results of the validation of the proposed factors for constructive engagement are presented. This thesis research used a combination of quantitative and qualitative data for the analysis part, as proposed by Rossman & Wilson (1984, 1991). This method was used for three reasons; to enable confirmation or corroboration of each proposition via triangulation, to provide new insights by exploring new ways of thinking, and to develop elaborate analysis which provided richer detail (Miles & Huberman, 1994). The analysis of the proposed model is twofold. First, quantitative analysis is done using partial least squares structural equation modeling. The statistical analysis will provide insight into how the proposed variables affect constructive engagement. The qualitative analysis makes use of representative quotes from the participants, and observation during the case study. The remainder of this chapter contains the threats to validity, the integration of the findings, and identifies opportunities for future work.

5.1 Quantitative analysis

The model proposed in chapter 4, with the hypothesized relations was tested using partial least squares structural equation modeling (PLS-SEM). In Figure 11 the average responses from the participants in the questionnaire are presented. These responses reflect the perceived level of the factors that affect constructive engagement in the S&OP process. In Table 4 the descriptive statistics of the responses are presented, including the minimum, maximum, mean, and standard deviation for each measured factor.

![Figure 11: Measured Factors of Constructive Engagement (Scale definition in table below)](image-url)

<table>
<thead>
<tr>
<th>Factor</th>
<th>0</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Cohesion</td>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Superordinate identity</td>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Top Management Support</td>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Centralization</td>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Information Quality</td>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Rewards &amp; Incentives</td>
<td>Never</td>
<td>Always</td>
</tr>
<tr>
<td>Procedural Quality</td>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Resources &amp; Time</td>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Collaboration</td>
<td>Never</td>
<td>Always</td>
</tr>
<tr>
<td>Functional Conflict</td>
<td>Never</td>
<td>Always</td>
</tr>
</tbody>
</table>
Bootstrapping is used to test the significance of the individual relation between the each variable and constructive engagement. Bootstrapping is a statistical technique where continuous resampling is performed to obtain estimates of summary statistics. Five-hundred bootstrap sub-samples were drawn for the proposed model, with a maximum of five-hundred iterations. The results from bootstrapping are presented in Table 5. In this table β represents the estimated coefficient of the relation between the respective variable and constructive engagement. The p-value represents the significance of the proposed relation. In this thesis a p-value below 0.05 is recognized as statistically significant. As discussed in chapter 3.4 the sample size is limited, raising some concerns for the validity of these results. This will be discussed in more detail in chapter 5.3.

The first proposed variable is social cohesion. A positive relation with constructive engagement was presumed. In the results of the bootstrapping analysis indeed a positive linear association was found, and against expectations, analysis identified this relation as significant (β = 0.684; p<0.05). These findings are in line with the research by Ambrose (2015) where a significant and positive linear relation is also found. The second variable is superordinate identity. A positive relation with constructive engagement was proposed. Bootstrapping analysis results suggest a positive relation with constructive engagement, however these findings are not significant (β = 0.769; p>0.05). In the research by Ambrose a positive and significant relationship was found with constructive engagement.

The next proposed positive relation between top management support and constructive engagement is neither found to be significant for this research. The results from the analysis do however suggest a positive relation (β = 0.832; p>0.05). This finding is more in line with expectations than the findings from Ambrose, where a negative significant relation was found.
The variable *centralization* was expected to have a negative effect on *constructive engagement* in the S&OP process. The results from bootstrapping seem to indicate that this negative association does indeed exist, since this negative relation is found to be significant in this test ($\beta = -0.713; p<0.05$). These findings are surprising since the relation was not found to be significant by Ambrose (2015). Although his research does also agree on a negative association, that is nearly significant.

The factor *resources & time* is proposed to positively affect constructive engagement. The results from bootstrapping however suggest a negative association, with the relation not found to be significant ($\beta = -0.907; p>0.05$). The findings by Ambrose (2015) indicate a very small effect on constructive engagement, negative for collaboration and positive for functional conflict. Neither is found to be significant.

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>p-value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructive Engagement</td>
<td>0.609</td>
<td>0.454</td>
<td>Not Supported</td>
</tr>
</tbody>
</table>

*Rewards & incentives* was proposed to positively affect the levels of *constructive engagement*. A positive relation is suggested by the results from analysis in Table 6, but this relation is not significant ($\beta = 0.901; p>0.05$). These findings are supported by the findings by Ambrose (2015) were a positive relation is also found. The positive effect of *S&OP performance* on *rewards & incentives* is suggested to be positive, but this relation is not significant ($\beta = 0.629; p>0.05$).

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>p-value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>S&amp;OP Performance</td>
<td>0.629</td>
<td>0.102</td>
<td>Not supported</td>
</tr>
</tbody>
</table>

In the proposed model *constructive engagement* has a direct positive effect on the variables *information quality* and *procedural quality*. The results of bootstrapping in Table 7 indicate a positive relation could exist, but this relation is not found to be significant ($\beta = 0.609; p>0.05$). In the research by Ambrose (2015) a direct effect from *information quality* to *constructive engagement* was proposed. This relation was not found to be significant.

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>p-value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructive Engagement</td>
<td>0.609</td>
<td>0.454</td>
<td>Not Supported</td>
</tr>
</tbody>
</table>

The model proposed in this thesis includes a direct positive effect of *constructive engagement* on *procedural quality*. The findings in Table 8 agree with the direction of the relation, but it is not found to be significant ($\beta = 0.884; p>0.05$).
In PLS-SEM the predictive capability of the proposed model is assessed with the use of $R^2$ determination. This value captures the combined effects of the independent factors on the dependent factors. In the model the independent factors are not affected by the levels of other variables in the models, but do impact the levels in the dependent factors. The dependent factors in the proposed mode include constructive engagement, information quality, procedural quality, and rewards & incentives. In Table 9 the $R^2$ value of 0.951 represents 95.1% of the variance in constructive engagement can be predicted by the independent factors in the model. This difference in the $R^2$ numbers can be explained by the number of independent factors affecting the dependent factor. Since information quality, procedural quality, and rewards & incentives are only impacted by a single independent variable, the $R^2$ values are expected to be lower.

### Table 9: R-square values of dependent variables

<table>
<thead>
<tr>
<th>Dependent Factors</th>
<th>$R^2$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructive Engagement</td>
<td>0.951</td>
</tr>
<tr>
<td>Information Quality</td>
<td>0.195</td>
</tr>
<tr>
<td>Procedural Quality</td>
<td>0.167</td>
</tr>
<tr>
<td>Rewards &amp; Incentives</td>
<td>0.356</td>
</tr>
</tbody>
</table>

5.2 Qualitative analysis

The informants of a case study research are identified by Miles & Huberman (1994) as the most logical sources of corroboration. The implied accumulated knowledge of people, process and products makes informants at the research organization a practical and viable judge to evaluate major findings of a study (Denzin, 1978). In this thesis research the technique presented by Miles & Huberman (1994) was used. With this technique the case study participants were presented with a summary of the findings, and were asked to evaluate the accuracy of factors in the proposed model of constructive engagement. Furthermore, the two members of the S&OP Project team who took part in the S&OP process redesign initiative were selected to validate the proposed model, and indicate the usefulness of the model for a future S&OP process redesign initiative. This was done to determine the practical use of the proposed model. First, factors are analyzed by evaluating representative quotes from respondents, and observations from the case study. Next, the role and importance of change management for large scale process redesigns are discussed. The two members of the S&OP Project team discussed and commented on each separate factor taken into account in the proposed model. Finally, the recognition of the results from the thesis research, and the usefulness of the proposed model for related process redesign initiatives are discussed.

5.2.1 Constructive Engagement

The role of constructive engagement is analyzed at the research organization by looking at both collaboration, and functional conflict. First representative quotes and observations regarding collaboration are discussed. Next, the functional conflict aspects of constructive engagement are presented.

**Constructive engagement – Collaboration**

During the case study, semi-structured interviews were conducted with the S&OP team members at the research organization. During the interviews with the participants of the case organization, different viewpoints on the level of collaboration were gathered. While some respondents argued that the current level of collaboration was already sufficient, others experienced lower levels of collaboration. However,
all respondents were positive about the setup and the results from the new meeting structures. The roles and responsibilities are more clearly divided, and the feasibilities and constraints of investigation provide more insight into other department’s activities.

**Participant 1 (S&OP Project Team):**
“It is very clear when people have the will to actively collaborate. In this situation they will start doing work that is not necessarily their own. You will get functional give-and-take situations. People know working together is not always easy, but they are engaged and willing to work together. This effort has to come both from Sales and the supply chain departments. Collaboration occurs frequently, specifically the weekly and monthly meetings are a fixed part of the S&OP agenda. Everyone involved is actively participating in creating common understanding and improve together.”

**Participant 4 (Operations):**
“Previously Sales entered the Sales orders in the ERP systems without checking the availability and feasibility of the requests. In the new process we do more investigation upfront and we are able to provide a more accurate and reliable confirmation date. The bandwidths in which we can confirm orders is more visible and better understood. We can provide transparency towards sales and the customer.”

**Participant 7 (Operations):**
“I think we already had a good level of collaboration, but now the roles and responsibilities are divided more clearly.”

**Constructive engagement - Functional Conflict**
During the interviews it became apparent that functional conflict played an important role during the cross-functional alignment meetings. Different organizational motives and viewpoints were named as potential causes for disagreements. Specifically, the different goals of the supply chain department and the sales department were of interest. While the supply chain department strives for a structured and constant production schedule, Sales prefers to offer a higher level of flexibility to easier meet the customer’s requests.

**Participant 1 (S&OP Project Team):**
“Sales and the supply chain departments have different goals. Sales wants to postpone making decisions and keep flexibility as long as possible, while the supply chain department want to make decisions as soon as possible. This is the biggest field of tension between the departments. The supply chain is prepared for a certain bandwidth of volume. When Sales wants to have a higher or lower volume this will lead to conflicts. So the main points of conflict are the increasing or decreasing of volume, and the levels of flexibility. You could start using some form of scenario planning where you can easily determine the costs and benefits for each case. This can assist in your decision making. In this past sales made assumptions about the capabilities and constraints. Now you have a master scheduler that has a clearer and more accurate understanding of the constrains of the supply chain and manufacturing. “

**Participant 4 (Operations):**
“In the new process there still will be different motives and interest between the departments. With the new process we facilitate the dialogue that is required to find the best solution for the organization as a
whole. We look at possibilities regarding deliveries times, and weigh it against the acceptance of the resulting costs.”

Participant 9 (Sales):
“In the new process we have functional conflict. I think in the end we should have our focus more on the customers than on the suppliers. I understand the importance of having a close relationship with your suppliers, but at the end this can also have an adverse effect. The new process allows Sales to really focus on the customers. In the end we will have to reach alignment. S&OP is not a simple tool to achieve this. This has more to do with the culture in a company. I don’t think a S&OP can just bring this directly. S&OP does bring different functional groups together. But if you decide that Sales only looks at the customers, and the supply departments only look at the supply chain, you will always arrive in a deadlock. At the end you reach an alignment but this is always a compromise. I think as a company you should make a decision about what your priority is. In this market, the sales department has visibility of only 3 months into the future. If you accept this as a company and figure out what this means for your supply chain and which costs are associated, you can make better decisions. This can have a price, but at the end at least everyone speaks the same language.”

5.2.2 Social Cohesion
In the interviews during the case study conduct, a friendly and positive atmosphere when working together was mentioned by nearly all members. The general feeling was that although people have different motives and discussions happen, these discussion are based on task or process conflicts, not personal conflicts. Multiple members mentioned that the social cohesion has improved since the implementation of the new S&OP process.

Participant 1 (S&OP Project Team):
“I am very positive about the level of social cohesion with the members of the team. The new process forces people to work together. Once the bridge is build, people want to collaborate. On a social level people get acquainted when they work together, and this makes communication a lot easier. This provides a good foundation to have discussions about topics that will have an impact on multiple departments. This is a benefit for the process. The first obstacle is usually the highest. When this is taken we can achieve the required level of collaboration for the process. “

Participant 3 (Sales):
“There is a friendly and positive atmosphere when we work together. Picking up the phone, or just going by someone’s desk it not an obstacle at all. I didn’t experience any emotion-based arguments.”

Participant 10 (Sales):
“It is clear everyone has their own motives in the process, but in the end we all get along well. I think the level of social cohesion is good.”

The opinions presented in the interviews were in line with the observations throughout the research period. Task and process conflicts were observed on multiple occasions, but members were always friendly and comfortable around each other. Most notably, every meeting ended on a good note with social small talk and friendly faces. The observations were in agreement with the findings by Ambrose (2015) and Nakata & Im (2010). Although social cohesion was present in moderate to high perceived
levels, it did not negatively affect functional conflict and the ability to critically consider multiple alternative solutions.

Previous literature indicates the positive effects social cohesion can have on exchange within teams, and as an important facilitator for communications. However, high levels of social cohesion are thought to lead to loss of creativity and creative thinking. In contrast, the research by Ambrose (2015) suggests high levels of social cohesion aid, not hinder the functional conflict aspects of constructive engagement. During the interviews the team members indicated moderate to high levels of social cohesion, and how it makes collaboration and communication easier.

5.2.3 Superordinate identity
The interviews with the S&OP team members suggested that although the respondents value their presence in the S&OP process redesign team, they still feel more connected to their respective departments. This indicated the current perceived levels of superordinate identity are low to moderate. In general, everyone agrees they are committed to common objectives. Examples of these long-term company-wide objectives include the increase of market share, and the increase of revenue and profit. However, each department has a different responsibility that will always get the priority on the short term. The frequency of the S&OP process is also mentioned. It makes sense employees identify more with the department they work with on a daily basis, then a team that collaborates on a monthly basis.

Participant 1 (S&OP Project Team):
“I think superordinate identity is currently at a low level. I think sales and production now feel they are obligated to work together. I think the identity lies more with their department than with the S&OP process. I think this also has to do with the frequency of the S&OP process. This is a monthly cycle, while for instance master scheduling is a weekly process.”

Participant 9 (Sales):
“I think the members of the project team feel like members of the team.”

The presented opinions in the interviews were in line with the observations throughout the research period. Observations showed members value their membership. However, group identity was only observed in the S&OP team. The surrounding functions were happy to be able to provide input into the process, but their department agenda was always leading. This is exactly where the challenges of creating group identity lies, as indicated by the literature.

Previous literature indicates the positive effects superordinate identity can have on innovativeness and cross-function integration. The findings from the research by Ambrose (2015) suggest a positive relation between superordinate identity and constructive engagement. The opinions presented in the interviews and the observations indicate superordinate identity may be hard to achieve, since operational work will be prioritized over the activities outside the normal work. However, since the S&OP process is a monthly cycle it will be crucial to establish and maintain superordinate identity in order to keep team members engaged.

5.2.4 Top Management Support
The interviews with the S&OP team members indicated that the respondents were mostly undecided about the level of top management support. This can be explained by the S&OP process being in a very early stage. Most respondents presumed that top management will be more involved once the process is
up-and-running. The program manager indicated that the top management support is present, otherwise the new S&OP process could have never started.

**Participant 1 (S&OP Project Team):**
“Top management support is absolutely crucial to the success of the project. From their support comes the ability to reserve time and resources.”

**Participant 2 (S&OP Project Team):**
“Top management support was present, otherwise the pilot wouldn’t have happened. It also should in the resources available for traveling and time reserved for the project. We were also allowed to actively look for people to fill the new roles for the process. Currently top management does not view the S&OP process as a high priority. The process first has to become more consistent, then the support will increase. The S&OP process is monthly and looks far ahead. Many people feel the here and now is more important, and order fulfillment is the first priority. Also we have very big difference in the maturity of the different locations.”

The presented opinions in the interviews were in line with the observations throughout the research period. Although the role of top management was not observed directly, resources were made available for the process, with the ability to reserve time for the process was the most frequently observed. The program manager, as well as other members were given significant time to work on the S&OP process and related tasks. This included the weekly meetings, and time reserved to present and inform stakeholders from various departments. Top management was also available to make final decisions when issues were escalated. The process design also specifies the role of top management in the actual S&OP process. Their active role illustrates that top management support is present.

Previous literature identifies top management support as the most critical driver for success of organizational changes (Balsmeier & Voisin, 1996; Li & Lin, 2006). Top management support is also mentioned as a prerequisite for group effectiveness and cross-functional collaboration (Cohen & Bailey, 1997). The research by Ambrose (2015) suggest top management support does not directly affect constructive engagement, nor S&OP performance. However, the perceptions presented in the interviews and the observations indicate top management support plays a crucial role in the S&OP process. This becomes mostly apparent in the available resources and time allocated to the implementation of the new S&OP process.

### 5.2.5 Centralization

Interview results suggest that the S&OP team members perceived varying levels of centralization. Multiple members mention that decisions were already made in principal on a high level, and that only the fine-tuning was left for the members. However, these viewpoints were more about the implementation process, than the actual S&OP process. During the actual S&OP process members are in fact empowered to make decision. However, when costs are involved, or issues cannot be resolved, top management does have the final say in these matters.

**Participant 2 (S&OP Project Team):**
“Some form is centralization is part of the S&OP structure. The monthly process contains a section where decisions are made, and where top management is involved. The S&OP team supports these decisions by making propositions and investigating different scenarios. It is possible to align within the team and reach a balance between supply and demand. If decisions can be made on this level it will happen. But when alignment can’t be reached or when costs are involved it will be escalated to higher levels.”
Participant 9 (Sales):
“I think the members in the S&OP process have a certain level of autonomy. Some things have to be escalated to higher management. When for instance we want to start looking into lead times, this will have an impact of the inventory levels. This of course has to be informed and accepted by higher management. The consequences of large decisions are felt by the whole organization, so top management should be involved.”

Observations about the level of centralization were mostly made by reviewing the flowcharts of the proposed S&OP process. Top management makes the final decision, and solves issues and escalations. However, observations confirmed that the S&OP team is empowered to make decisions. Multiple decisions are made by the team to make a final selection of scenarios that are presented to top management. Smaller decisions in a short time horizon can even be made without escalation. The positive effect of empowerment become apparent in multiple interviews where the members of the S&OP team expressed their positive impression with the new form of meetings. These meetings allowed the team to share information and reach alignment in a very short time. It can also be noted while empowerment is very positive for the engagement of the S&OP team members, top management will always be informed and have the final say in issues involving the strategy of expenses of the organization.

In previous literature high levels of centralization are suggested to negatively affect exchange of information, and constructive functional conflict. The findings by Ambrose (2015) indeed showed a negative relation, meaning high levels of centralization are likely to have a negative impact on constructive engagement. The opinions presented in the interviews, and the observations did not indicate high levels of centralization at the research organization. Although large decisions and escalations can be solved by higher management, the S&OP team has autonomy and can make smaller decisions. In addition they fulfill an important role in preparing the scenarios and decisions that are presented to higher management.

5.2.6 Information Quality
The S&OP team members of the case organization were still undecided about the information quality. Although all respondents expected the information quality to be improved with the new process, it was unsure how and when this will materialize. Creating more transparency and ‘speaking the same language’ were named as indicators of improved information quality. Respondents were positive about the increased sharing of sales forecasts by sales, and the improved identification of supply chain constrains, that are promised to receive special attention in the new S&OP process. However, a member of the sales department foresaw challenges to increase the time horizon from 6 months to 18 months into the future.

Participant 2 (S&OP Project Team):
“We have identified information quality as a potential problem. Currently the quality of the forecasts is quite low. We have to develop methods to measure the quality, and define the level of quality we want to maintain. The quality of information sharing was a priority in the implementation of the S&OP process. S&OP is the driving forces of your decision making, and this is only possible when the information quality is guaranteed. We still have to make steps to reach the required level. The horizon of the future is currently not far enough. The supply chain needs to look 18 months ahead to plan for large investment.”
Participant 9 (Sales):
“We are now in the starting phase where we are looking which forecasts are currently good. From this analysis we will develop more reliable forecasts, and translate this to the future. The responsibility of the correctness of the forecasts lies with Sales. The forecasts are shared with [participant 3] and [participant 1]. We are still developing the tools to assist in making the forecasts. We are now looking 6 months into the future. We can also look 18 months into the future, but I have my question marks about the reliability of this. We have a distinction between complete lines where we have a visibility of 7-9 months. But on the stand-alone machine we can’t really look any further than 3 months. I think this will be one of the most difficult things in the S&OP process, how you work with this limited visibility in the sales of the future.”

Participant 10 (Sales):
“I expect the quality of information sharing will improve with the new process. Sales has a better understanding of the constraints of the factory. This will help in providing a more reliable delivery time towards the customers. In the current situation we didn’t see the problems of the supply chain until after we placed the orders in the ERP system.”

Observations throughout the case study revealed the main perceived shortcomings in regards to information quality concern the quality of sales forecasting. In fact, much of the volumes communicated to suppliers were based on historical numbers, more than on sales forecasts. Sales did create independent demand, but the accuracy and reliability were taken into question. It proved difficult to create a clear picture, since no information about reliability was gathered. This again indicates steps can be made in improving the quality of information. Information quality was identified as attribute that had to be improved in the new S&OP process. It was even labelled as a potential problem, indicating that is was in fact taken into account the S&OP process redesign.

In previous literature information quality has received relatively much attention. Sharing of information is identified as a prerequisite for group collaboration. A previous case-study suggested the important role information role plays in enabling constructive engagement. In the research by Ambrose (2015) it was suggested information quality affects S&OP performance, but it does not flow through constructive engagement. In fact, it was suggested constructive engagement leads to information. This idea is in line with the observations. The development of a structured way to share information can only be achieved through cross-functional collaboration.

5.2.7 Procedural Quality
In the interviews with the S&OP team members it became apparent that the participants were quite confident about the procedural quality, but more clarity was required in some areas. One respondent mentioned the new process shares a lot of similarities to the old process, making it easy to understand. Another respondent reported that the new process design looks good on paper, but awareness and involvement still have to be raised across different functional groups. Other issues that were brought up are the lack of clarity about the overall scope and goals of the process. Related to this, the time line and the ‘dot on the horizon’ were not always perceived as clear to the respondents. The project manager agreed that improvements are required. A better common understanding has to be created among the participants, including speaking the same language, and clarity about the roles and responsibilities. Lastly, the member of the sales department reported some uncertainty regarding the perceived quality of the S&OP process.
Participant 1 (S&OP Project Team):
“Currently the process is clear to the members who were involved in the pilot. But there are improvement needed in the knowledge department. The whole communication around the new process will take time to complete. The general topics like terms and definitions must be better understood by everyone. I’ve noticed that the current level of knowledge is not on the required level yet. This has an impact on the quality of the meetings, since people are not fully sure of what is expected from them. Especially the communication and speaking the same language are very important for the process. We have determined the scope of the project beforehand. Still, there was some miscommunication or misunderstanding about this. But in the end the process was very much the same as we planned it with the S&OP project team.”

Participant 7 (Operations):
“The process is clear to me, but the timelines of the project are not clear yet. We don’t know when the implementation has to be complete.”

Participant 9 (Sales):
“I still have my question marks with the new process. In the old situation we were very flexible and the customer could make the final decision at a very late time. I’m not sure if the new process can support this.”

During the case study some mild conflicts were observed. Procedural quality was the cause for nearly all of the conflicts. Since the implementation was in the early stages, a lack of clarity about the scope and the timelines were present. The definition and development of process went hand in hand with observations of constructive engagement. Cross-functional collaboration was required to map out a process containing all relevant process steps and stakeholders.

In the literature procedural quality is identified as an important predictor for group effectiveness. In the research by Ambrose (2015) a direct relation between constructive engagement and S&OP performance was found. This finding is in line with the case study research by Olivia & Watson (2011) who propose constructive engagement can actually positively impact the procedural quality, not the other way around. This variable is thought to behave is a similar way to information quality, were cross-functional engagement is a requirement to achieve an agreed-upon process in the first place.

5.2.8 Rewards & Incentives
The interviews with the S&OP team members revealed that the research organization does not tie any money-based rewards and incentives to the performances linked to the S&OP process. Many respondents reported being unsure or undecided, since no formal communication about this topic was provided. The program manager did confirm the implementation of team-based rewards and incentives was not in the short term plans, but it would be a nice thing to have. Of particular interest are quotes by a member of the S&OP core team, who indicated non-monetary rewards and incentives include the access to certain information, and being invited to certain meetings.

Participant 1 (S&OP Project Team):
“For the quality of the process I think it would be good to have some rewards based on shared performance. For instance, keeping the inventory levels would could be an incentive for the team.”
Participant 2 (S&OP Project Team):
In order for the new process to work and be accepted we had to take away the old incentive structures. These are not strictly monetary rewards. For instance attending the old meetings and receiving information can also be seen as rewards. We are not looking to tie rewards to team performance.

Participant 4 (Operations):
“We haven’t had any confirmations that rewards will be based on the performance in the process. Currently I haven’t received confirmation that I will be getting the job when the process is implemented. If I get the job I will be satisfied.”

Gathering information through observations was difficult for this attribute, since the rewards structure was not clear from the start. However, it became apparent that the company-shared variables such as the inventory costs are a key indicator of the success of the new S&OP process. This fact was brought up in multiple meetings. However, it was unclear if any bonuses or other monetary incentives were tied to this performance indicator. The observations were in line with the findings by Olivia & Watson (2011) who indicate the lack of aligned incentives can fuel functional conflict, and thus potentially increase constructive engagement.

In previous literature rewards and incentives are proposed as key prerequisites for group effectiveness (Hackman et al., 2000). In the research by Ambrose (2015) this variable is identified as the single most influencer of constructive engagement. The insights from the interviews indicate the outcomes or performance of the S&OP process provide the most important incentive to engage in the S&OP process. This idea is in line with the findings of Olivia & Watson (2011), who propose the positive relation between perceived process quality and perceived benefit of participating in the S&OP process. This in turn positively affects the levels of constructive engagement (Olivia & Watson, 2011). The performance of the S&OP process is thought to increase the level of constructive engagement if the outcomes are aligned with S&OP team members’ rewards and incentives. The alignment quality determines if the perceived quality of the S&OP performance leads to constructive engagement.

5.2.9 Resources & Time
Participant 2 (S&OP Project Team):
“IT does facilitate the S&OP process. We are currently working with a low maturity IT, but are making steps to make it help the process. First we have to make sure all the roles and responsibilities are known and in place. Next we can start looking at how IT can assist. Tooling is needed for the process, but we also have to make sure there is uniformity in how for instance information is shared. Not every department or location should use a different format.”

Participant 3 (Sales):
“Currently top management does not reserve specified amounts of time to work on the deployment of the S&OP process. Therefore operational work has the priority since this has to be finished in a shorter time horizon than the project that can take months to years to complete.”

Participant 7 (Operations):
“I disagree with having enough time for the project. Some people were unable to reserve time to work on the project, since operational work has the priority. Therefore they had to work late in order to do both.”

Observations indicated that indeed some team members got into trouble with their available time, and had to work late to finish all their tasks. These issue could mostly be attributed to the learning curve that
is associated with the initial implementation phase. Observing the process models and flowcharts make it highly likely that all members have adequate time to prepare and work on their tasks for the S&OP process.

In the literature the lack of time and resources is identified as a possible cause for the lower priority S&OP related tasks receive in comparison to operation activities. The availability of adequate time and resources, including IT facilities, can affect the levels of constructive engagement. In the research by Ambrose (2015) a significant relation was not found. However from the observations it was identified that a lack of resources can decrease the willingness to engage in the S&OP process.

5.2.10 S&OP Performance
Since the S&OP process was not fully implemented at the research organization at the time of this research, it was not possible to report on the S&OP performance improvements. Therefore, the participants could only report their expectations about which performance improvements the new S&OP would bring. From both the opinions provided in the interviews, and observed during the case study it became apparent the participants were expecting performance results closely related to the performance measures of their respective departments. For instance, participants from the supply chain department emphasized the decrease of inventory as an indicator of success, while participants from the sales department indicated measures of success included higher sales, and shorter order fulfillment times. These observations are in line with the research by Olivia & Watson (2011), who identify the relation between the perceived benefits of participating in the S&OP process, and the perception of the S&OP process outcome quality.

5.2.11 Analysis of practical use
In this section the practical use of the proposed model is analyzed. The model developed in this thesis could be used by managers during the implementation of a S&OP process. Chase (2013) states navigating a successful S&OP journey is 60% change management, 30% process, and 10% technology. This observation is recognized by the two key informants at the research organization. Both participants of the S&OP project team agree change management was a crucial part of the S&OP process redesign project. One informant states the change management aspects is even more crucial to the outcome of the redesign than the process quality.

Participant 1 (S&OP Project Team)
“Change management is the most thrilling aspects of this process. Developing and writing down the process can be a brainteaser, but once this is done the next big challenge is how you get the involved people to support and participate in the new process. I think this is the most complex aspect of the entire project. I think this is the most critical part of the entire implementation. For the outcome of a new process you have two variables; the quality of the new process, and the acceptance of the people involved. The multiplication of these variables is the results. Both have to be positive, but I think the change management aspects should weigh even heavier than the process quality.”

Participant 2 (S&OP Project Team)
“I think change management is a critical part of the S&OP implementation. Did we pay enough attention to this aspect? Of course there is never enough attention paid to it. But until now we haven’t encountered any real show stoppers. The pilot project is executed, and the perceptions were positive of both outcomes and change management level. Change does cost time, but we have created a lot of awareness.”
The next part of this qualitative analysis is a comprehensive discussion of the two participants’ perception of the variables taken into account in the proposed model for constructive engagement.

Social cohesion was not taken into account explicitly during the S&OP process redesign project. However, awareness of the importance of social cohesion was observed during the case study. A kick-off meeting was organized at the beginning of the pilot to introduce the background of the S&OP process. During this meeting attention was given to introduce and familiarize the S&OP project team members with each other. The overall perceptions were positive, and social cohesion was found to be increased during the project.

The informants perceived the level of superordinate to be relatively low at the time of the interviews. Most employees tend to identify themselves with the functional groups were they work in a daily routine. The monthly frequency of the S&OP process is identified as a potential threat to the level of superordinate identity.

Top management support was identified by the informants as a crucial factor for the success of the process redesign. Without top management support it would be impossible to attain the required resources and time for a process redesign of this scale.

The two informants expects some level of centralization will always be required in the S&OP process. Although the S&OP team is empowered to make create and propose different scenarios for decision making, the end decisions involving investments will always be made by top management. Other decisions can be made on lower levels in the organization. Unless issues are escalated to higher management, centralization will not decrease the level of constructive engagement. Information quality was identified explicitly by the two participants as a potential risk for the success and outcome of the S&OP process redesign. Decision making is based on the provided information. This means the quality of information will have an important role in the S&OP process. Examples of shared information are bill of material (BOM) structures, and sales forecasts. Both sources of information are defined and improved through cross functional efforts, meaning constructive engagement will have an important role in the improvement of information quality.

Procedural quality was given a large amount of attention during the S&OP process redesign project. The definition and development of the new processes was described as a cross functional task, with people from different department working together in multiple sessions. From these statements the importance of constructive engagement to achieve constructive engagement was concluded.

Rewards and incentives were not taken into account in the S&OP process redesign by the project team. However, steps were taken to assure constructive engagement would not be hindered by existing performance assessments. Rewards and incentives are not only measured in money, but can also include access to certain information, or being invited to meetings.

Resources and time are identified by the informants as potential risks during the S&OP process redesign project. Some employees had to take on new or different roles and activities in the new process. This required some S&OP team participants to work overtime during periods of the implementation. However, these strains of time and resources were only applicable to the implementation period. During the regular process time and resources and managed and should not threaten the level of constructive engagement.
In addition to the variables considered in the proposed model for constructive engagement, the maturity of the order fulfillment process was recommended to be the foundation of the S&OP process. Although this suggestion was not taken into further account for the proposed model, it will be explained in the discussions section.

To conclude the qualitative analysis, the proposed model was presented to the members of the S&OP project team at the research organization. The opinions presented in the semi-structured interviews provide a positive assessment of the usefulness of the proposed model. One participant describes the implementation of the new S&OP process as a journey. Without defining targets for the different variables it was impossible to know which steps still had to be taken to achieve the stated goals.

Participant 1 (S&OP Project team)
“I think it would have helped if we paid more attention to these variables from the start. Unconsciously you take certain aspects into account, but it’s good to make is measurable upfront. You assess the current status, and define where you would like to end up. This would have given us a clearer beginning and ending of the project. At a certain moment during the implementation, discussions about roles and the scope of the project occurred. This model would have helped in making the variables that should be taken into account visual. The changes in perceptions could be the spark of discussion. Now we know we are on a journey, but we can’t really they how far we are.”

“I would use this proposed model for future comparable projects. The factors that speak to me the most are the internal team factors. I think this is something that is consistently neglected. People have a tendency to focus on processes, and assume the people involved possess the adequate level of skills, and are able to interact and communicate in a proper manner. If this model makes it possible for use to measure these perceptions, than we can start working with it. Currently this is something we find difficult to do. “

Participant 2 (S&OP Project team)
“I think this model could have been used for the implementation, however I’m not sure it could only be this model. It is good that you have a model where all important variables are presented in a clear way. Especially for people working in functions where different functional groups have to be aligned, it would be convenient to know which variables have to be taken into account. It provides the foundation to start discussion and solve issues.”

“The questionnaires used during this case study could be sent out periodically, to measure how well we are currently doing. If there are big gap between the goals, this should be discussed. Then a decision has to be made in the status quo is adequate or we will have to work on some aspects.”

5.3 Threats to Validity
In this chapter the threats to the validity of the findings are discussed. During the case study information was gathered using various sources; documents, interviews, observations and questionnaires. These sources formed the basis on which the conclusions were drawn. In order to draw meaningful conclusions from case study findings, several research-oriented quality criteria have to be met (Yin, 1994). The most important criteria of research quality are controllability, reliability and validity (Van Aken et al., 2007). In the following these criteria are reviewed.
Controllability
Controllability is the first criteria for research quality, and entails a precise description of how the research was conducted. This includes providing information of the methods used for data collection, data analysis, participant selection, case study context and the contents of interviews and questionnaires. This detailed description of the research allows other to replicate the process, and check possible disparities in the outcomes. This criterion was controlled for by proving the research design in this chapter about the research method. Furthermore the results for the actual research are presented as precisely as possible (Swanborn, 1996). This includes the graphical presentation of results from the questionnaires, and presenting representative quotes and opinions of the members of the case study organization.

Reliability
The reliability criterion for quality is met when the results of a research are independent of the particular characteristics of the study, meaning other studies can achieve the same results (Yin, 1994; Swanborn, 1996). Four potential sources of bias are recognized in the literature; the researcher, the instruments, the respondents, and the situation (Van Aken et al., 2007). In this thesis research, researcher bias was minimized by making use of standardized questionnaires to measure the variables of collaboration. The other method for increasing the reliability was the following of explicit procedures for data collection, analysis and interpretation (Swanborn, 1996). The procedures for the case study followed the guidelines by Yin (1994). Instrument bias was minimized by using triangulation. The input from the exploratory interviews, documentation, observations and the results from the questionnaire were used for the final interviews. In addition, the findings of this research by making use of triangulation outside the research. The findings from the research by Ambrose (2015) were used to compare and validate the findings of this research. These different research instruments may provide complementary or contradictory results (Van Aken et al., 2007). Contradictions occur when interviewees act or say something other than they do. Therefore using only a single instrument is likely to yield unreliable results. This thesis research used triangulation to minimize the instrument bias. Respondent bias was minimized by selecting members of different functional departments that were affected by the implementation of a S&OP process. The second way to reduce the risk of respondent bias is to use a large number of respondents. For this research a sample of ten people was selected. The bias of the situation was minimized by carrying out the study at different moment in time (Van Aken et al., 2007). This allowed the researcher to make observations in different situations, and become more aware of the context in the case study organization.

Validity
The third major criterion for the quality of research results is validity. A research result is valid when the way it is generated provides good reason to believe the adequateness and truth of the findings (Van Aken et al., 2007). Therefore, a relation exists between the used methods and the findings. The validity criterion can be broken down into three types; construct validity, internal validity and external validity (Yin, 1994; Swanborn, 1996). The construct validity refers to the extent to which an instrument measures what it is intended to measure. Construct validity was achieved by making use of questionnaires that have been tested and validated in previous research. The internal validity was achieved by presenting the views and opinions of members of different functional groups. This decreased the chance that important issues and relations were overlooked during the research. Internal validity is suggested by the findings of the
interviews and questionnaires. The answers of the respondents do not differ to large extent, indicating some level of agreement between the respondents. The external validity refers to the generalizability of the findings. The use of a single case study research design, and the small sample size of ten participants in the quantitative analysis poses a threat to the external validity. Usually multiple cases have to be studied to find generalizable results. Therefore the findings from this case study were compared to the findings of the survey-based research by Ambrose (2015).

Recognition of results
The previous three criteria for research criteria are frequently mentioned and prominently present in traditional methodological literature. Another criterion mentioned by Van Aken et al. (2007) for the quality of research results is the recognition of these results. This refers to the extent to which the problem owner or organization members recognize the findings of the research. Results should sound reasonable, plausible or at least possible to the members of the research site (Van Aken et al., 2007). In this research the findings from the interviews, observations and questionnaires were discussed with members of the S&OP implementation team. This provided insight if taking the proposed model of factors affecting constructive engagement into account during a S&OP process adds value from a managerial point of view.

5.4 Integration
In this section the findings of the quantitative and qualitative analysis are integrated. The model proposed in this thesis builds on the models in previous work by Ambrose (2015) and Olivia & Watson (2011). During the quantitative and qualitative analysis opinions from key informants at the research organization were collected. In this chapter these findings are summarized.

Internal Team Factors
The factors social cohesion and superordinate identity make up the internal team factors. These variables were of particular interest to one of the members of the S&OP Project Team who states these variables are consistently neglected, or at the very least not taken into account explicitly for large process redesign projects.

Quantitative analysis of the model provided a significant and positive linear effect of social cohesion on constructive engagement. This finding is in line with the expectations, as the research by Ambrose (2015) suggest the same linear relation. Surprisingly however was that the analysis from this thesis research provided a significant effect, while this was not found by Ambrose (2015). This result can indicate social cohesion is a crucial factor to achieve constructive engagement in the early stages of S&OP implementation.

The results from the questionnaires show the respondents perceive high levels of social cohesion. A friendly and positive atmosphere was observed during the case study. Although conflicts did occur, these were caused by functional conflict, not personal conflict. Both the interviews, questionnaire answers and the observations suggest high levels of social cohesion do not hinder, but in fact increase constructive engagement. This could reject the claim that high levels of social cohesion stifle critical dialogue as suggested by Janis (1982) and Sethi et al. (2001). In fact, according to a respondent social cohesion provided a foundation to have discussions about topics that will have an impact on multiple departments. This suggest both aspects of constructive engagement, collaboration and functional conflict, can be increased by high levels of social cohesion. Achieving social cohesion should be regarded a high priority component of a S&OP process implementation.
Although the effect of superordinate identity on constructive engagement was found to be positive, a significant effect was not found. Medium to high levels of superordinate identity were measured for the factor superordinate identity. This was surprising as the S&OP process was in the early stages of implementation at the time of the case study. The S&OP team did work together on a weekly basis, which could have increased the perceptions of feeling part of the same team. However, the interviews and observations provide a different picture on the perceived level of superordinate identity. Although the respondents value their presence at the team, indications are that they feel more connected to their respective departments. During the interviews the frequency of the S&OP process was given as an explanation for the moderate levels of superordinate identity. The duration and the early stages of the S&OP process at the research organization did not provide a conclusive answer. This is expected as superordinate identity is expected to develop and grow over time. In the research by Ambrose (2015) a significant and positive relation was found, but only respondents with extended experience participated in his research. The findings from this thesis research indicate constructive engagement can be achieved at a S&OP team were superordinate identity is still developing.

**External Team Factors**

The level of centralization, and the amount of available resources and time are part of the external team factors. High levels of centralization are presumed to decrease the level constructive engagement, while especially low availability of resources and times are expected to negatively affect constructive engagement.

The factor centralization was indicated as low by the respondents in the questionnaire. In the research model a negative effect of centralization on constructive engagement was proposed. Quantitative analysis supports this presumption, as a significant and negative relation from centralization to constructive engagement was found. Besides the factor social cohesion, this is the only other factor that was found to have a significant impact on constructive engagement. The opinions expressed by the respondents during the interviews indicated some levels of centralization are part of the S&OP structure. Top management has the final say when larger decisions have to be made. However, the S&OP team plays an important role in the preparations and selection of scenarios on which the decision are made. The findings from this research reiterate the suggestions of previous work by Guenter & Grove (2015), who suggest lower levels of centralization can lead to increased constructive engagement. This is in agreement with the quantitative research by Ambrose (2015) were a negative effect on constructive engagement approaching significance was found. The findings in this thesis research can be of great value for practitioners. Low levels of centralization indicate the S&OP team in the case study feels empowered (Tavares Thomé et al., 2012). The quantitative analysis in this thesis suggest this contributes to increased levels of constructive engagement. The findings in this thesis indicate providing adequate levels of empowerment should be taken into account by managers during S&OP process implementation.

The factor resources and time was indicated as medium by the respondents in the questionnaires. In the research model a positive relation between the level of available resources and time, and constructive engagement was proposed. Against expectations a strong negative relation was found instead. The opinions expressed in the interviews suggested the respondents perceived low to mediate levels of available resources and time. This can be attributed to the additional work required during the implementation which was added on top of the structural work that had to be done. The access and ability of IT facilities were also mentioned as limited. Members of the S&OP team mentioned activities for their respective department would frequently receive priority over S&OP related activities. Still, the statistical analysis shows constructive engagement can be achieved without high levels of resources and time. This
is in agreement with the observations where constructive engagement was detected, while restrictions in available time and resources were present. The findings of this thesis research suggest constructive engagement can be achieved despite moderate levels of resources and time being available for the members of the new S&OP process. This suggestion is of importance to managers, since the implementation of a new process will often add work on top of the regular activities. Time and resources should still be managed, but low to moderate levels do not necessarily obstruct achieving constructive engagement during a S&OP process implementation.

**Process Quality**

The variables information quality and procedural quality are grouped under process quality. This aggregation is in line with the S&OP process quality model by Olivia & Watson (2011), who found constructive engagement improved participant perceptions of informational, and procedural quality. In future work, additional factors could be added to further measure and define the factors of process quality.

Moderate levels of information quality were indicated by the respondent in the questionnaires. Statistical analysis did not find a significant effect of constructive engagement on information quality. In a S&OP context, sales forecasts in particular are frequently mentioned as key indicators of information quality (Mello & Stahl, 2011; Stahl & Wallace, 2012). In the case study the respondents were mostly undecided about the quality of information. This can be explained by the S&OP process at the research organization being in the early stages of implementation. Methods and processes for sharing information and sales forecasts were being developed at the time of the research. However, expectations were that the increased collaboration due to the S&OP process would lead to increased information sharing. In particular the communication of the constraints of the supply chain and assembly lines were named as positive developments.

The findings of this case study on the relation between constructive engagement on informational quality are not conclusive. This can be attributed to the processes and formats on information exchange being in a stage of development during the case study. However, the positive expectations of respondents expressed in the interviews are in line with the positive effect of constructive engagement on information quality identified by Olivia & Watson (2011). According to expectation, information exchange is under development during early stages of S&OP implementation. However, the combination of collaboration and functional conflict could play an important role in the development of sharing information effectively.

The statistical analysis of the factor procedural quality indicates the respondents perceive moderate to high levels of procedural quality. Although a significant relation was not found, the findings suggest a positive effect of constructive engagement on procedural quality.

Despite the S&OP process being in the early stages of implementation, the respondents expresses confidence in the quality of the process. One respondent mentioned the new process shares a lot of similarities to the old process. The timeline of the implementation and the new roles were not fully clear to some of the respondents. During the case study constructive engagement was observed during the development of new process. Both dimensions of constructive engagement, collaboration and functional conflict, occurred during working sessions.

During the case study the process was still partially under development. Still, the respondents already perceived the procedural quality as moderately high. This can be attributed to the similarities between new and the previous process, as indicated by one of the respondents. The positive perception of procedural quality could also be caused by the clear way of presenting the new process to all stakeholders before and during the implementation phase. The new process was presented during information meetings, detailed flowcharts and promotional booklets containing summarized details about the new
S&OP process. The findings of the case study suggest the importance of informing and engaging the stakeholders during the early stages of S&OP implementation.

S&OP Performance
For most managers the performance of the S&OP performance will be the most important factor of the proposed model. Unlike the other factors presented in this model this is arguably the hardest to achieve. Many factors go into the performance of the newly designed process. Whereas the manager can affect the other factors to some extent, S&OP performance improvement are less likely to be achieved with the efforts of one person or a small group of people. In this model S&OP performance mainly serves as the outcome of process quality, as proposed by Olivia & Watson (2011). In addition the S&OP performance is proposed to positively affect constructive engagement, flowing through alignment quality. The results from quantitative analysis suggest a positive effect of S&OP performance on rewards & incentives. This relation was resulted in a low p-value despite the small sample size, providing motivation for further research on this relation.

Incentives Alignment Quality
In the same way information quality and procedural quality are grouped under the variable process quality, the measured factor rewards and incentives is grouped under incentive alignment quality. Alignment quality was not part of Ambrose’s Model of S&OP performance (2015), therefore a reinforcing structure from S&OP performance to constructive engagement was not taken into account. However, previous work provided the motivation to consider the positive effect on constructive engagement. The relations presented in the model of constructive engagement in this thesis are in line with the proposed model of Olivia & Watson (2011). In their paper the quality of the S&OP process outcomes positively affects the perceived benefits of participating in the S&OP process, flowing through perceptions of the S&OP process quality (Olivia & Watson, 2011). In this thesis incentive alignment quality is defined as the degree to which the incentives landscape ensures the goals of a department are in line with the goals of the organization as a whole. This can be illustrated by taking the supply chain department from the case study research as an example. For this department reducing inventory levels, and the associated costs, is an important measure of S&OP performance. This measure was of great meaning to this department, since these costs were located on the department’s profit and loss (P&L). The perceived benefit of participating in the S&OP process, was to lower the inventory costs, and in turn receive rewards and incentives which are attributed to this performance indicator.

In the questionnaires the respondents indicated a moderate-low level of the factor rewards and incentives. This means currently the S&OP team members are not frequently rewarded for team-shared results. Additionally, the respondents were unsure if incentives would be tied to the S&OP process outcomes in the future. Still, quantitative analysis suggest a positive relation exist between rewards and incentives on constructive engagement. Although this relation is not found to be significant, it is in line with the quantitative research by Ambrose (2015). In fact, in the research by Ambrose (2015) this factor was found to have the single biggest effect on constructive engagement. Again, it must be noted the respondent in the research by Ambrose (2015) already worked within a S&OP process for a longer period of time.

The interviews with the members of the S&OP team provided more insight into the undecided answers in the questionnaires. Answers indicate the case study organization does not currently tie any money-based rewards and incentives directly to activities in the S&OP process. One respondent suggests the importance of the role of non-monetary rewards, such as invitation to certain meetings and access to certain information.

No rewards directly tied to S&OP activities were present at the research organization. However, the respective departments of the S&OP team members all have key performance indicators. Observations
during the case study showed how misaligned incentives can initiate functional conflict. These observations are in line with the findings of Oliva & Watson (2011), who found out constructive engagement can exist despite misaligned incentives. The findings of this research and the research by Ambrose (2015) indicate the rewards and incentives can have a direct effect on constructive engagement. Although the reinforcing structure could use more research in future work, the case study have provided motivation to believe a reinforcing structure could exist in a S&OP context.

**Top Management Support**

The findings in the research by Ambrose (2015) did not support the proposed positive influence of top management support on constructive engagement. However, the role of top management support should not be discarded. As indicated by the key informants from the S&OP project team resources and time can never be secured without top management support. In a similar way, the distribution of rewards and incentives cannot be approved without high level support.

Top management support was perceived as moderate by the respondents in the questionnaires. A positive, but not significant effect on constructive was found during quantitative analysis. Ambrose (2015) suggest top management could be of particular importance during the early stages of a S&OP process implementation, since during this stage resources and time have to be made available for the development and introduction of the new process.

During the interviews the respondents indicated they were undecided about the level of top management support. However, they did acknowledge the time and resources that were made available for the implementation of the new S&OP process. One respondent indicates without top management support the new process wouldn’t have happened. These statements are in line with the observation during the case study. Although top management was not actively involved in the development and implementation, adequate time was made available for the S&OP team.

Although a significant relation between top management support and constructive engagement was not found in this research, findings suggest top management does play an important role in the success of the S&OP process. Further research is needed to provide the conclusive nature of top management support, and how it affects the other factors in the research model. Still, since any S&OP process initiative will claim time and resources of the people involved, managers should acknowledge top management support should always be secured before initiating any S&OP initiative. Since top management support is recognized as the single most important driver of success for any significant change within an organization (Li & Lin, 2006), failing to earn support of top management could lead to failure of the S&OP initiative (Milliken, 2008).

**5.5 Future work**

In future work the proposed model should be analyzed and validated using a larger sample of participants, preferably working in different organizations and industries. Perspectives of all stakeholders of the S&OP process should be taken into account. To ensure this, multiple people operating in different departments of an organization should be interviewed. In the research by Ambrose (2015) a sample size of around 100 respondents provided significant findings. In addition to increasing the sample size, the period of the research could be extended. This would allow a researcher to track the development of factors during a longer period time, and get more insight into how these factors impact constructive engagement.

Future work has the potential to extend the proposed model by adding factors. Especially the reinforcing structure, representing the effect of S&OP performance on constructive engagement is in need of additional research. Both cases where the S&OP performance is higher and lower than expected should be analyzed. This could provide insight into the legitimacy of a reinforcement structure as proposed by Olivia & Watson (2011), and included in the research model in this thesis.
The previous models by Ambrose (2015) and Olivia & Watson (2011) discussed in this thesis are conducted in the United States of America. It could be interesting to conduct case studies in different countries and continents. Cultural factors could be taken into account. For instance, Asian countries could show higher levels of centralization, and American case studies could show more importance with regards to the factor rewards and incentives. The models could be compared, taking cultural difference into account.

Finally the role of top management support in the context of the S&OP process should be investigated in more detail, specifically into during which phase of this factor is of most importance.

6. Conclusion

The purpose of this master thesis report is to identify the factors affecting constructive engagement, particularly in the early stages of a S&OP process implementation. Analysis of previous work indicates the need for the development of a comprehensive understanding of how S&OP should be implemented. This need is evident by the high percentage of S&OP process implementation initiatives that do not achieve the intended results (Milliken, 2008; Wagner, 2013).

The improved performance associated with implementing a S&OP process is highly dependent on achieving a mix of collaboration and functional conflict, that is required in a cross-functional team-based setting such as the S&OP process. Given this setting, constructive engagement is identified as a crucial factor in the success of a S&OP process. An integrated model of factors considered to affect constructive engagement is analyzed quantitatively and qualitatively with the help of a case study.

The findings of this case study suggest the factors social cohesion and centralization are crucial factors for achieving constructive engagement during the early stages of a S&OP process implementation. Dispute a limited sample, significant effects on constructive engagement were identified. While high levels of social cohesion positively affect constructive engagement, centralization reduces constructive engagement in the S&OP process. The other seven factors in the proposed model were not found to significantly affect constructive engagement. Still, findings from the case study indicate securing the support of top management is identified as vital for achieving any operational changes. Observations during the case study suggest informing and engaging the stakeholders can increase the perceived level of procedural quality. The findings of the case study suggest constructive engagement can be achieved despite the absence of high levels of resources and time, and rewards and incentives tied to outcomes of the S&OP process. Finally, the findings suggest constructive engagement can be present despite moderate levels of superordinate identity and information quality.

The empirical and theoretical groundings of the proposed model suggest the potential for meaningful implications for both researchers and practitioners. The internal validity of the research suggest the findings could be applicable to similar cases. For researchers the model provides the integration of previous work. The model can serve as the foundation for additional research where factors are added or subtracted from the model, based on findings of quantitative or qualitative research.

Practitioners can benefit from the presented findings from an organization that was in the early stages of implementing a S&OP process. The proposed model can serve as a framework to identify the factors which should be incorporated during the implementation of a S&OP process. During the case study, respondents indicated the factors in the proposed model can serve as a guideline for managers during a S&OP process implementation initiative.

The small sample size available during the case study prohibited conclusive findings, particularly in terms of external validity. Therefore, additional research is recommended to further reveal the role and relations of the identified factors in a S&OP context.
Appendix

Appendix 1 – Reference list


APICS dictionary: http://www.apics.org/gsa-main-search#dictionary


Appendix 2 – Ambrose (2015) Research Summary

Hypotheses

• H1: There is an inverted U-shaped association between social cohesion among S&OP team members and constructive engagement of the S&OP team.
• H2: There is a positive association between superordinate identity of the S&OP team and constructive engagement of the S&OP team.
• H3: The positive association between superordinate identity of the S&OP team and constructive engagement of the S&OP team will be strengthened as social cohesion among team members increases from low to moderate levels.
• H4: The positive association between superordinate identity of the S&OP team and constructive engagement of the S&OP team will be weakened as social cohesion among team members increases from moderate to high levels.
• H5: There is a positive association between S&OP related information quality and constructive engagement of the S&OP team.
• H6: There is a positive association between procedural quality of the S&OP process and constructive engagement of the S&OP team.
• H7: There is a positive association between top management support for S&OP and constructive engagement of the S&OP team.
• H8: There is a negative association between centralization and constructive engagement of the S&OP team.
• H9: There is a positive association between S&OP team-based rewards/incentives and constructive engagement of the S&OP team.
• H10: The association between rewards/incentives and constructive engagement of the S&OP team will be weakened as S&OP related information quality increases.
• H11: The association between rewards/incentives and constructive engagement of the S&OP team will be weakened as procedural quality of the S&OP process increases.
• H12: There is a positive association between resources/time allocated to S&OP team members and constructive engagement of the S&OP team.
• H13: There is a positive association between constructive engagement of the S&OP team and S&OP performance.
• H14: The greater the market turbulence, the stronger the association between constructive engagement of the S&OP team and S&OP performance.
• H15: The greater the technological turbulence, the stronger the association between constructive engagement of the S&OP team and S&OP performance.

Sample:
100 respondents, consisting of 57 responders representing sales and 44 responders representing operations.

Questionnaire items:
Social Cohesion: This study adopted the social cohesion scale from Nakata and Im (2010) containing four items. The items were rated on a seven-point Likert-type scale, with 1 = “Strongly Disagree” and 7 = “Strongly Agree” and the Cronbach’s alpha for this measure was .89.

Superordinate Identity: This study used the superordinate identity scale from Nakata and Im (2010) containing six questions. The items were rated on a seven-point Likert-type scale, with 1 = “Strongly Disagree” and 7 = “Strongly Agree.” The Cronbach’s alpha score was .91.

Information Quality: This study adopted the information quality scale from Li and Lin (2006) containing five items. The items were rated on a Likert-type scale, with 1 = “Strongly Disagree” and 5 = “Strongly Agree” and the Cronbach’s alpha score for this measure was .88.

Procedural Quality: The planning process formalization scale from Nakata and Im (2010) was adapted for this study. The items were rated on a seven-point Likert-type scale, with 1 = “Strongly Disagree” and 7 = “Strongly Agree” with a Cronbach’s alpha score of .86.

Top Management Support: This study used the top management support scale from Li and Lin (2006) containing four items. The items were rated on a seven-point Likert-type scale, with 1 = “Never” and 7 = “Always.” The scale anchors were modified from their original form as “Strongly Disagree” and “Strongly Agree” and the scale points were modified from 5 to 7 in order to mitigate common method variance. The Cronbach’s alpha was .89.

Centralization: This study used the centralization scale from Menon et al. (1997) containing five items. The items were rated on a Likert-type scale, with 1 = “Strongly Disagree” and 7 = “Strongly Agree” with a Cronbach’s alpha score of .89. The original scale points were modified from 5 to 7 in order to mitigate common method variance.

Rewards and Incentives: The rewards and incentives scale contains eight items adapted and based loosely on the joint-reward scales used in Xie et al. (2003) and Song et al. (2007). The items were rated on a five-point Likert-type scale, with 1 = “Never” and 5 = “Always.” The Cronbach’s alpha measure for this scale indicated a reliability score of .87.

Resources/Time: The scale developed by Ambrose (2015) contains seven items newly created for this study. The items were rated on a five-point Likert-type scale, with 1 = “Strongly Disagree” and 5 = “Strongly Agree” with a Cronbach’s alpha score of .85.

Constructive Engagement: The constructive engagement scale is composed of two dimensions: collaboration and functional conflict. For the collaboration dimension, this study used items from Kahn and Mentzer (1998) and collaboration descriptors from Min et al. (2005). It consists of four items rated on a seven-point Likert-type scale, with 1 = “Never” and 7 = “Very Frequently”, achieving a Cronbach’s alpha score of .88. Functional conflict was measured using the six-item scale from Massey and Dawes (2007) rated on a seven-point Likert-type scale, with 1 = “Never” and 7 = “Very Frequently.” The Cronbach’s alpha score for the functional conflict dimension was .81.

Appendix Table 1: Hypothesis testing results Ambrose (2015)
### Constructive Engagement

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Predictors</th>
<th>Collaboration</th>
<th>Functional Conflict</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$\beta$</td>
<td>$t$ value</td>
<td>$p$ value</td>
</tr>
<tr>
<td>H1 Social Cohesion (Quadratic)</td>
<td></td>
<td>0.00</td>
<td>0.07</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>Social Cohesion (Linear)</td>
<td>0.12</td>
<td>0.96</td>
<td>0.16</td>
</tr>
<tr>
<td>H2 Superordinate Identity</td>
<td></td>
<td>0.38</td>
<td>3.24</td>
<td><strong>0.00</strong>*</td>
</tr>
<tr>
<td>H3 Social Cohesion X Superordinate Identity (Low to Moderate)</td>
<td></td>
<td>0.23</td>
<td>1.01</td>
<td>0.31</td>
</tr>
<tr>
<td>H4 Social Cohesion X Superordinate Identity (Moderate to High)</td>
<td></td>
<td>-0.11</td>
<td>0.45</td>
<td>0.65</td>
</tr>
<tr>
<td>H5 Information Quality</td>
<td></td>
<td>0.11</td>
<td>1.16</td>
<td>0.12</td>
</tr>
<tr>
<td>H6 Procedural Quality</td>
<td></td>
<td>0.14</td>
<td>1.38</td>
<td>0.08</td>
</tr>
<tr>
<td>H7 Top Management Support</td>
<td></td>
<td>-0.18</td>
<td>2.19</td>
<td><strong>0.01</strong>*</td>
</tr>
<tr>
<td>H8 Centralization</td>
<td></td>
<td>-0.11</td>
<td>1.33</td>
<td>0.09</td>
</tr>
<tr>
<td>H9 Rewards/Incentives</td>
<td></td>
<td>0.35</td>
<td>4.26</td>
<td><strong>0.00</strong>*</td>
</tr>
<tr>
<td>H10 Information Quality X Rewards/Incentives</td>
<td></td>
<td>-0.59</td>
<td>3.66</td>
<td><strong>0.00</strong>*</td>
</tr>
<tr>
<td>H11 Procedural Quality X Rewards/Incentives</td>
<td></td>
<td>0.41</td>
<td>2.02</td>
<td><strong>0.02</strong>*</td>
</tr>
<tr>
<td>H12 Resources/Time</td>
<td></td>
<td>-0.05</td>
<td>0.67</td>
<td>0.25</td>
</tr>
</tbody>
</table>

### S&OP Performance

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>$\beta$</th>
<th>$t$ value</th>
<th>$p$ value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>H13 Collaboration</td>
<td>0.37</td>
<td>4.10</td>
<td><strong>0.00</strong>*</td>
<td>Supported</td>
</tr>
<tr>
<td>H13 Functional Conflict</td>
<td>0.30</td>
<td>3.05</td>
<td><strong>0.00</strong>*</td>
<td>Supported</td>
</tr>
<tr>
<td>H14 Market Turbulence X Collaboration</td>
<td>-0.28</td>
<td>0.92</td>
<td>0.18</td>
<td>Not Supported</td>
</tr>
<tr>
<td>H14 Market Turbulence X Functional Conflict</td>
<td>0.65</td>
<td>1.93</td>
<td>0.03**</td>
<td>Supported</td>
</tr>
<tr>
<td>H15 Technological Turbulence X Collaboration</td>
<td>0.05</td>
<td>0.18</td>
<td>0.43</td>
<td>Not Supported</td>
</tr>
<tr>
<td>H15 Technological Turbulence X Functional Conflict</td>
<td>-0.37</td>
<td>1.32</td>
<td>0.09</td>
<td>Not Supported</td>
</tr>
</tbody>
</table>

**$p<.05$; ***$p<.01$**
Appendix figure 1: Hypothesis testing results model Ambrose (2015)

Internal Team Factors
- Social Cohesion
- Superordinate Identity

Contextual Influencers
- Top Management Support
- Centralization
- Information Quality
- Rewards/Incentives

Environmental Factors
- Market Turbulence
- Technological Turbulence

Outcome
- S&OP Performance
- Resources/Time RT_3-7

Procedural Quality

Note: The numbers represent path coefficients. For two consecutive numbers, the first number refers to the association with the collaboration dimension of constructive engagement and the second number refers to the functional conflict dimension. **p<.05; ***p<.01
Dear S&OP Team member,

for my Master Thesis I am conducting a research study about the S&OP process. With this questionnaire I would like to gain insight into your experiences and opinions about the implementation of the S&OP process at your organization. This includes the changed roles of the Master Scheduler and the Demand Planners.

Results from this questionnaire will not be shared with other team members. Your answers will be used as input for a follow-up interview with me.

With your answers in this questionnaire and the final interview, I hope to prove the value of implementing the S&OP process at your organization.

Since the process has not yet been fully developed and implemented, please answer the question based on your expectations once the process has been implemented.

The questionnaire consists of 10 constructs, and will take 10-15 minutes to complete.

Thank you!

Stijn Moons
## Social Cohesion:
**Thinking about the S&OP team, to what extent do you agree or disagree with the following statements:**

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Undecided</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Members of the S&amp;OP team are very comfortable with each other.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Members of the S&amp;OP team are very friendly with each other.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Our S&amp;OP team has a very pleasant working atmosphere.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Members of the S&amp;OP team are committed to maintaining close interpersonal relationships.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Super ordinate identity:
**Thinking about the S&OP team, to what extent do you agree or disagree with the following statements:**

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Undecided</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Members of the S&amp;OP team are committed to common project objectives.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Members of the S&amp;OP team feel strong ties to the team.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Members of the S&amp;OP team behave like a unified team.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Members of the S&amp;OP team value their membership in the team.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Members of the S&amp;OP team feel that they have a personal stake in the success of the team.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Members of the S&amp;OP team behave like departmental representatives who are driven by their respective departmental agendas. (a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Top Management Support:
**Thinking about the S&OP process at your company, to what extent do you agree or disagree with the following statements:**

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Top management considers the S&amp;OP process to be important.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Top management supports the S&amp;OP team with the resources that we need.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Top Management regards S&amp;OP planning as a high priority item.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Top Management participates in S&amp;OP planning and its optimization.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Centralization:

**Thinking about the S&OP process at your company, to what extent do you agree or disagree with the following statements:**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Undecided</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>There can be little action taken by the S&amp;OP team until upper management approves.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decisions made purely by the S&amp;OP team would be quickly discouraged by upper management.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Even small matters have to be referred to upper management for a final answer.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>We have to ask upper management before we do almost anything.</td>
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<tr>
<td>Any decision that we make as an S&amp;OP team has to have approval from upper management.</td>
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</tr>
</tbody>
</table>

### Information Quality:

**Thinking about the S&OP process at your company, to what extent do you agree or disagree with the following statements:**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Information exchange within our S&amp;OP team is timely.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Information exchange within our S&amp;OP team is accurate.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3 Information exchange within our S&amp;OP team is complete.</td>
<td></td>
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</tr>
<tr>
<td>4 Information exchange within our S&amp;OP team is adequate.</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>5 Information exchange within our S&amp;OP team is reliable.</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Rewards and Incentives:

**Thinking about the S&OP process at your company, to what extent do the following things occur?**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Never</th>
<th>Rarely</th>
<th>Undecided</th>
<th>Frequently</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Our senior management promotes team loyalty over functional loyalty.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2 Team members are evaluated based on team performance instead of individual performance.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Departments share equally in the rewards from achieving S&amp;OP goals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 There are team based rewards for achieving customer service targets.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 There are team based rewards for achieving inventory management targets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Formal evaluation criteria are used for S&amp;OP teamwork.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>7 The team receives recognition when S&amp;OP goals are exceeded.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The team receives financial incentives for exceeding S&OP goals.

| Procedural Quality: Thinking about the S&OP process at your company, to what extent do you agree or disagree with the following statements: |
|---|---|---|---|---|---|
| 1 In our S&OP process, plans have a specific format that is used by everyone. | Strongly Disagree | Disagree | Slightly Disagree | Undecided | Slightly Agree | Agree | Strongly Agree |
| 2 We have clearly defined procedures for completing each step in the process. | | | | | | | |
| 3 We know which information sources are to be used in developing S&OP plans. | | | | | | | |
| 4 We have a precise timetable for completing the S&OP process. | | | | | | | |

| Resources and Time: Thinking about the S&OP process at your company, to what extent do you agree or disagree with the following statements: |
|---|---|---|---|---|---|
| 1 Members of the S&OP team have adequate time to work on S&OP-related tasks. | Strongly Disagree | Disagree | Slightly Disagree | Undecided | Slightly Agree | Agree | Strongly Agree |
| 2 Members of the S&OP team receive education on S&OP best practices. | | | | | | | |
| 3 Members of the S&OP team rarely miss scheduled S&OP meetings due to conflicting agendas. | | | | | | | |
| 4 The information technology supporting our S&OP process is adequate. | | | | | | | |
| 5 Sufficient time is allocated for the S&OP process to be completed. | | | | | | | |
| 6 Our company provides adequate resources to support the S&OP process. | | | | | | | |
| 7 Members of the S&OP team receive training on effective teamwork practices. | | | | | | | |

<p>| Constructive Engagement: During the past six months, to what degree did the S&amp;OP team pursue the following activities and experience the following conditions: |
|---|---|---|---|---|---|
| Collaboration | Never | Very | Rarely | Undecided | Occasionally | Frequently | Very | Frequently |
| 1 Engage in joint planning. | | | | | | | |
| 2 Have a mutual understanding. | | | | | | | |
| 3 Informally work together. | | | | | | | |
| 4 Achieve goals collectively. | | | | | | | |</p>
<table>
<thead>
<tr>
<th><strong>Functional conflict</strong></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Have consultative interaction and useful give-and-take.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2 Differing opinions or views focus on issues rather than individuals</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3 Even people who disagree respect each other’s viewpoints.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4 Disagreements between teammates impair discussion of issues. (a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5 There are constructive challenges of ideas, beliefs, and assumptions.</td>
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<tr>
<td>6 Team members are comfortable raising dissenting viewpoints.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(a)= reverse coded

<table>
<thead>
<tr>
<th><strong>Market Turbulence:</strong></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Undecided</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 In our kind of business, customers’ product preferences change quite a bit over time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Our customers tend to look for new products all the time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3 We are witnessing demand for our products and services from customers who never bought them before.</td>
<td></td>
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<tr>
<td>4 New customers tend to have product-related needs that are different from those of our existing customers.</td>
<td></td>
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</tr>
<tr>
<td>5 We cater to much the same customers that we used to in the past. (a)</td>
<td></td>
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<tr>
<td>6 Sometimes our customers are very price sensitive, but on other occasions, price is relatively unimportant.</td>
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<td></td>
</tr>
</tbody>
</table>

(a)= reverse coded

<table>
<thead>
<tr>
<th><strong>Technological Turbulence:</strong></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 The technology in our industry is changing rapidly.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Technological changes provide big opportunities in our industry.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 A large number of new product ideas have been made possible through technological breakthroughs in our industry.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4 Technological developments in our industry are rather minor. (a)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5 It is very difficult to forecast where the technology in</td>
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</tbody>
</table>
our industry will be in the next 2-3 years.

(a) = reverse coded

| S&OP Performance: Thinking about the S&OP process at your company, to what extent do you agree that the process (in the future) will accomplish the following: |
|---|---|---|---|---|---|---|---|
| 1 | Increased forecast accuracy. |
| 2 | Increased supply chain visibility and hence reduced the risk of supply chain disruption |
| 3 | Reduced inventory levels and thus cost of capital while maintaining or improving customer service levels. |
| 4 | Improved customer satisfaction levels. |
| 5 | Improved product availability for marketing and promotional campaigns. |
| 6 | Reduced the number of expedited shipments and rush orders. |
| 7 | Reduced the amount of obsolete products. |
| 8 | Increased the return on assets (ROA). |
| 9 | Increased capacity utilization. |
| 10 | Better balanced production and sourcing costs against transportation and safety stock costs. |
| 11 | Driven revenue growth through clearer focus on high margin products. |
| 12 | Increased sales and generated top line revenues. |
Appendix 4 - Questionnaire Results

Social cohesion
This thesis research has adopted the social cohesion scale with four questions, as developed by Nakata & Im (2010), and adapted for S&OP by Ambrose (2015). The participants were asked to rate their perceived levels of social cohesion on a seven-point Likert scale, with the lowest score being “strongly disagree”, and the highest score being “strongly agree”. In the graphs the lowest score translates to 0, and the highest score to 1. The graphs presented in Figure 12 show the perceptions of the three groups, as well as the overall averaged line.

Figure 12: Social cohesion responses

Superordinate identity
This thesis research has adopted the superordinate identity scale with six questions, as developed by Nakata & Im (2010), and adapted for S&OP by Ambrose (2015). The participants were asked to rate their perceived levels of superordinate identity on a seven-point Likert scale, with the lowest score being “strongly disagree”, and the highest score being “strongly agree”. In the graphs the lowest score translates to 0, and the highest score to 1. The graphs presented in Figure 13 show the perceptions of the three groups, as well as the overall averaged line.

1. Members of the S&OP team are very comfortable with each other.
2. Members of the S&OP team are very friendly with each other.
3. Our S&OP team has a very pleasant working atmosphere.
4. Members of the S&OP team are committed to maintaining close interpersonal relationships.
Visual inspection shows moderate to high perceived levels of superordinate identity, with a notable exception for question 6. This question measures to what extent S&OP members are able to abandon their role as departmental representatives. The responses seem to indicate that S&OP team members are driven by their departmental agenda. The functional bias that could stem from this behavior can make the forming of group identity challenging (Alexander, 2013; Wallace & Stahl, 2008). Interestingly the S&OP team scores the highest perceived levels of superordinate identity. This make sense as these respondent are most actively involved in the S&OP process, as thus consider themselves part of the team.

Top management support
This thesis research has adopted the top management support scale with four questions, as developed by Li and Lin (2006), and adapted for S&OP by Ambrose (2015). The participants were asked to rate their perceived levels of top management support on a five-point Likert scale, with the lowest score being “strongly disagree”, and the highest score being “strongly agree”. In the graphs the lowest score translates to 0, and the highest score to 1. The graphs presented in Figure 14 show the perceptions of the three groups, as well as the overall averaged line.
Centralization

This thesis research has adopted the centralization scale with five questions, as developed by Menon et al. (1997) and adapted for S&OP by Ambrose (2015). The participants were asked to rate their perceived levels of top management support on a seven-point Likert scale, with the lowest score being “strongly disagree”, and the highest score being “strongly agree”. In the graphs the lowest score translates to 0, and the highest score to 1. The graphs presented in Figure 15 show the perceptions of the three groups, as well as the overall averaged line.

Figure 15: Centralization results
Visual inspection shows low perceived levels of centralization, with a notable difference for group 3. This group has a number of participants being undecided about the level of centralization, and some respondents that perceive centralization as present. Specifically the role of top management as the concluding argument in escalated issues might have fueled this perception.

Information Quality

This thesis research has adopted the information scale with five questions, as developed by Menon et al. (1997) and adapted for S&OP by Ambrose (2015). The participants were asked to rate their perceived levels of information quality on a five-point Likert scale, with the lowest score being “strongly disagree”, and the highest score being “strongly agree”. In the graphs the lowest score translates to 0, and the highest score to 1. The graphs presented in Figure 16 show the perceptions of the three groups, as well as the overall averaged line.

![Figure 16: Information quality responses](image)

Visual inspection of the graphs reveals an overall undecided perception. Most responses were slightly positive, slightly negative or undecided. This makes sense as the procedures to share information were still being developed at the time.

Rewards & incentives

This thesis research has adopted the centralization scale with eight questions adapted for S&OP by Ambrose (2015), based on previous research (Xie et al., 2003; Song et al., 2007). The participants were asked to rate their perceived frequency of team-based rewards and incentives on a seven-point Likert scale, with the lowest score being “Never”, and the highest score being “Always”. In the graphs the lowest score translates to 0, and the highest score to 1. The graphs presented in Figure 17 show the perceptions of the three groups, as well as the overall averaged line.
Visual inspection of the graphs shows most members feel team-based rewards and incentives are given out infrequently or are still undecided. Noteworthy are the peaks for questions 1, 3 and 7. Question 3 can be explained by almost all members being undecided, which translates to a score of 0.5. In question 1 and 7 loyalty and recognition are mentioned respectively. It makes sense that these two questions are score higher, since they don’t contain a reference to rewards. The respondents tended to associate this with money, while loyalty and recognition are social rewards.

During the case study, semi-structured interviews were conducted with the S&OP team members at the research organization. In these interviews it became apparent the research organization does in fact not tie any money-based rewards and incentives to the performances linked to the S&OP process. Many respondents reported being unsure or undecided, since no formal communication about this topic was provided. The program manager did confirm the implementation of team-based rewards and incentives was not in the short term plans, but it would be a nice thing to have. Of particular interest are quotes by a member of the S&OP core team, who indicated non-monetary rewards and incentives include the access to certain information, and being invited to certain meetings.

In previous literature rewards and incentives are proposed as key prerequisites for group effectiveness. In the research by Ambrose (2015) this variable is identified as the single most influencer of constructive engagement. The insights from the interviews indicate the outcomes or performance of the S&OP process provide the most important incentive to engage in the S&OP process. This idea is in line with the findings of Olivia & Watson (2011), who propose the positive relation between perceived process quality and perceived benefit of participating in the S&OP process. This in turn positively affects the levels of constructive engagement (Olivia & Watson, 2011). The performance of the S&OP process is thought to
increase the level of constructive engagement is the outcomes are aligned with S&OP team members’ rewards and incentives.

Procedural quality
This thesis research has adopted the procedural quality scale with four questions, as developed by Nakata and Im (2010), and adapted for S&OP by Ambrose (2015). The participants were asked to rate their perceived levels of procedural quality on a seven-point Likert scale, with the lowest score being “strongly disagree”, and the highest score being “strongly agree”. In the graphs the lowest score translates to 0, and the highest score to 1. The graphs presented in Figure 18 show the perceptions of the three groups, as well as the overall averaged line.

Visual inspection of the graphs shows a moderately positive level of perceived procedural quality. It makes sense the respondent were still undecided or moderately positive about the procedural quality, given the process was still under development at the time of the questionnaire. In some cases, considerable discussions occurred about the clarity and scope of the process.

During the case study, semi-structured interviews were conducted with the S&OP team members at the research organization. In these interviews it became apparent the participants were quite confident about the procedural quality. One respondent mentioned the new process shares a lot of similarities to the new process, making it easy to understand. Another respondents reported that the new process design looks good on paper, but awareness and involvement still have to be raises across different functional groups. Other issues that were brought up are a lack of clarity about the overall scope and goals of the process. Related, the time line and the ‘dot on the horizon’ were not always perceived as clear to the respondents. The project manager agreed that improvements are required. A better common understanding has to be created among the participants, including speaking the same language, and clarity about the roles and
responsibilities. Lastly, the member of the sales department reported some uncertainty regarding the perceived quality of the S&OP process.

In the literature procedural quality is identified as an important predictor for group effectiveness. In the research by Ambrose (2015) a direct relation between constructive engagement and S&OP performance was found. This finding is in line with the case study research by Olivia & Watson (2011) who propose constructive engagement can actually positively impact the procedural quality, not the other way around. This variable is thought to behave is a similar way to information quality, were cross-functional engagement is a requirement to achieve an agreed-upon process in the first place. Therefore constructive engagement is thought to positively affect procedural quality. This leads to the eighth and ninth proposed variables.

Resources and time
This thesis research has adopted the resources/time scale with seven questions developed by Ambrose (2015). The participants were asked to rate their perceived availability of resources and time on a seven-point Likert scale, with the lowest score being “strongly disagree”, and the highest score being “strongly agree”. In the graphs the lowest score translates to 0, and the highest score to 1. The graphs presented in Figure 19 show the perceptions of the three groups, as well as the overall averaged line.

Visual inspection of the graphs shows the respondents are undecided or slightly disagree with having enough time. They are also unsure if they will receive additional training to support the S&OP process. The information technology is perceived as adequate, but only just.
In the literature the lack of times and resources is identified as a possible cause for the lower priority S&OP related tasks receive in comparison to operation activities. The availability of adequate time and resources, including IT facilities, can affect the levels of constructive engagement. In the research by Ambrose (2015) a significant relation was not found. However from the observations it was identified that a lack of resources can decrease the willingness to engage in the S&OP process. This leads to the following proposed variable.

Constructive engagement

Collaboration

**Figure 20: Constructive engagement responses**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Engage in joint planning.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Have a mutual understanding.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Informally work together.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Achieve goals collectively.</td>
<td></td>
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</tbody>
</table>

This thesis research has adopted the collaboration scale with four questions developed by Ambrose (2015), based on indicators by Kahn and Mentzer (1998) and Min et al. (2005). The participants were asked to rate their perceived frequency of collaboration on a seven-point Likert scale, with the lowest score being “never”, and the highest score being “very frequently”. In the graphs the lowest score translates to 0, and the highest score to 1.
This thesis research has adopted the functional conflict scale with six questions developed by Massey & Dawes (2007), and adapted by Ambrose (2015). The participants were asked to rate their perceived frequency of functional conflict on a seven-point Likert scale, with the lowest score being “never”, and the highest score being “very frequently”. In the graphs the lowest score translates to 0, and the highest score to 1.

S&OP performance

This thesis research has adopted the S&OP performance scale with six questions developed by Wagner et al. (2013), and adapted by Ambrose (2015). The participants were asked to rate their perceived level of S&OP performance on a seven-point Likert scale, with the lowest score being “strongly disagree”, and the highest score being “Strongly agree”. In the graphs the lowest score translates to 0, and the highest score to 1.
Appendix 5 - SMART PLS Model and results

[Diagram of SMART PLS Model and results]
SMART PLS

Error message – remove questions

Partial Least Squares Algorithm
The PLS path modeling method was developed by Wold (1982) and the PLS algorithm is essentially a sequence of regressions in terms of weight vectors. The weight vectors obtained at convergence satisfy fixed point equations (see Dijkstra, 2010, for a general analysis of such equations and ensuing convergence issues).

After Calculation: Open Full Report Close Start Calculation

Collecting data.
Calculating full data set.
Sample size too small. There must be at least 11 cases/observations. (Double click for more information!)

Partial Least Squares Algorithm
The PLS path modeling method was developed by Wold (1982) and the PLS algorithm is essentially a sequence of regressions in terms of weight vectors. The weight vectors obtained at convergence satisfy fixed point equations (see Dijkstra, 2010, for a general analysis of such equations and ensuing convergence issues).

Sample Size too Small
The sample size for estimating the PLS path model must be at least the maximum number of indicators in a measurement model or the maximum number of predictors (exogenous) variables in a structural regression.

Problem
To estimate the system of regressions in PLS path modeling, there need to be at least the number of independent variables + 1 (degrees of freedom) as observations for each regression in the model. Otherwise estimation of the regressions is not possible. The problem often occurs for data groups for which the sample size is smaller than for the overall full sample model. Each data group must fulfill the minimum sample size requirements to be estimated.

How to Solve it?
Increase the sample size or remove data groups that do not fulfill the minimum sample size requirements.
SMART PLS – Boot strapping results (significance)

### Path Coefficients

<table>
<thead>
<tr>
<th></th>
<th>Original Sample Mean</th>
<th>Sample Mean</th>
<th>Standard Deviation</th>
<th>T Statistics</th>
<th>P Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralization</td>
<td>0.500</td>
<td>10.210</td>
<td>28.737</td>
<td>0.017</td>
<td>0.986</td>
</tr>
<tr>
<td>Constructive</td>
<td>0.483</td>
<td>0.246</td>
<td>0.866</td>
<td>0.725</td>
<td>0.487</td>
</tr>
<tr>
<td>Constructive</td>
<td>0.386</td>
<td>0.480</td>
<td>0.407</td>
<td>0.948</td>
<td>0.388</td>
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<tr>
<td>Resources</td>
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<td>1.005</td>
<td>4.291</td>
<td>0.200</td>
<td>0.846</td>
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<tr>
<td>Rewards &amp; L.</td>
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<td>20.163</td>
<td>56.259</td>
<td>0.010</td>
<td>0.992</td>
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<tr>
<td>S&amp;OP Performance</td>
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<td>0.742</td>
<td>0.095</td>
<td>6.355</td>
<td>0.000</td>
</tr>
<tr>
<td>Social Cohe.</td>
<td>-0.206</td>
<td>-15.849</td>
<td>44.076</td>
<td>0.005</td>
<td>0.996</td>
</tr>
<tr>
<td>Superordination</td>
<td>-0.216</td>
<td>10.262</td>
<td>26.901</td>
<td>0.008</td>
<td>0.984</td>
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<tr>
<td>Top Manag.</td>
<td>0.587</td>
<td>-7.457</td>
<td>21.875</td>
<td>0.027</td>
<td>0.979</td>
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### Path Coefficients

<table>
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<tr>
<th></th>
<th>Original Sample Mean</th>
<th>Sample Mean</th>
<th>Standard Deviation</th>
<th>T Statistics</th>
<th>P Values</th>
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</thead>
<tbody>
<tr>
<td>Centralization</td>
<td>0.500</td>
<td>10.210</td>
<td>28.737</td>
<td>0.017</td>
<td>0.980</td>
</tr>
<tr>
<td>Constructive</td>
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<td>0.246</td>
<td>0.867</td>
<td>0.798</td>
<td>0.000</td>
</tr>
<tr>
<td>Constructive</td>
<td>0.386</td>
<td>0.460</td>
<td>-0.627</td>
<td>0.703</td>
<td>0.000</td>
</tr>
<tr>
<td>Resources</td>
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<td>-69.299</td>
<td>0.600</td>
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SMART PLS – Bootstrapping method
1 variable at a time

**Bootstrapping**

Bootstrapping is a nonparametric procedure that can be applied to test whether coefficients such as outer weights, outer loadings and path coefficients are significant by estimating standard errors for the estimates.

### Basic Settings
- **Subsamples**: 500
- **Do Parallel Processing**: Off
- **Sign Changes**
  - No Sign Changes
  - Construct Level Changes
  - Individual Changes
- **Amount of Results**
  - Basic Bootstrapping
  - Complete Bootstrapping

### Advanced Settings
- **Confidence Interval Method**
  - Percentile Bootstrap
  - Studentized Bootstrap
  - Bias-Corrected and Accelerated
  - Davidson Hinkley’s Double Bootstrap
  - Only Double Bootstrap

### Basic Settings
- **Weighting Scheme**
  - Centroid
  - Factor
  - Path
- **Maximum Iterations**: 500
- **Stop Criterion (10^{-X})**: 10

### Advanced Settings
- **Initial Weights**
  - Use Lohmöller Settings
  - or configure individual initial weights

---

After Calculation: Open Full Report ▼ Close Start Calculation

---

**Start Calculation**
Correlations, Mean, % of Maximum score, and Standard deviations

<table>
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<tr>
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<th>2.</th>
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Results from bootstrapping

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