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Challenges and evaluation

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2016

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Citation for published version (APA):

HULTHÉN, HANA. (2016). *On understanding of external and internal integration in supply chains: Challenges and evaluation*. [Doctoral Thesis (compilation)]. Lund University.

Total number of authors:

1

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On understanding of external and internal integration in supply chains

- Challenges and evaluation

Hana Hulthén



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ISBN 978-91-7623-934-6 (print)
ISBN 978-91-7623-935-3 (pdf)
ISRN LUTMDN/TMTP--1059—SE

Printed in Sweden by Media-Tryck, Lund University
Lund 2016



Acknowledgements

This dissertation marks the end of my PhD studies. It has been a long, challenging but ultimately rewarding journey which would not be possible without the support of several people. I would like to take this opportunity to thank all the people who have contributed in the different aspects of this thesis. They have all made it possible for me to start and accomplish this task and therefore they all deserve my special thanks.

First and foremost I want to express my gratitude to Prof. Dag Näslund, my supervisor, for his valuable support during the planning and development phase of this research, as well as during the stage of finalizing the dissertation. You also earn a special 'thank you' for your advice and assistance in keeping my progress on schedule. I am also highly grateful to Prof. Andreas Norrman, my assisting supervisor. You guided me during the process after my licentiate. You have spent much of your time reading the articles and kappa and provided me with a constructive critique and much appreciated suggestions on how to improve this work. I am also very grateful for an insightful discussion and the invaluable comments received on the pre-defense seminar of this dissertation from Dr. Linea Kjellsdotter Ivert. I also wish to thank Dr. Anders Ljungberg and Prof. Helena Forslund for providing me with constructive feedback on my licentiate thesis which resulted in two of the appended papers.

I would also like to offer my special thanks to Prof. Jan Olhager for his time, constructive suggestions and discussions; Prof. Sten Wandel for challenging the research and giving me inspiration, and to Asst. Prof. Kostas Selviaridis for patiently listening to my challenges and providing me kindly with valuable advice. I would like to acknowledge that I highly appreciate all the inspiring discussions, support and kindness of my friends and colleagues in academia; especially, I would like to thank you Joakim, Sebastian, Malin, Ala, Fredrik, Hoda, Ali, Carina and Johan. During the PhD program I also received support from all other colleagues at the department of Industrial Management and Logistics.

I wish to acknowledge my great appreciation to all respondents from the companies who kindly agreed to participate in this research. The results are founded on their valuable input and insights.

Last but not least, I would like to express my very great appreciation to my family and friends for their tremendous support and understanding during the last five years. Johnny, thank you so much for staying by my side and always encouraging me during this challenging time. Without you I would not be able to finish this project. Thank you, Anna, for having a lot of patience with your busy mom working long hours. Finally, thank you, Ivan,

for our stimulating discussions, inspiring ideas and feedback as well as for helping out with Anna whenever needed.

August 2016, Lund

Hana

Abstract

Benefits of implementing Supply Chain Integration (SCI) are acknowledged in existing integration literature. Integration extending beyond functional silos and firm boundaries is expected to provide value for customers in terms of higher quality, improved service level, and reduced costs. In addition, internal integration allows business functions to align around a single company goal. This type of integration promotes value creation while decreasing redundancies and costs.

Yet, regardless of the significant advances in research and practice, many organizations still experience difficulties not only to integrate activities with supply chain partners, but they also struggle to integrate activities within an organization, for example, through implementation of a sales and operations planning (S&OP) process.

To tackle these challenges, organizations may need to reconsider why and how they integrate both internally and externally. However, the previous integration research provides only limited guidelines for how to carry out such evaluations. Many organizations experience difficulties in addressing the complexity related to integration and evaluation of activities internally and with SC partners. The lack of concrete guidelines for evaluation of SCI in theory is seen as one of the reasons for the still sporadic examples of successful SCI in practice.

Thus, the overall purpose of this research is to increase understanding of external and internal integration in supply chains. To address the purpose, three studies (1-3) have been conducted. The study 1 highlighted the current status and several *SCI challenges* in academic literature and in practice. One of the major challenges relates to the absence of a systematic comprehensive approach for evaluation of internal and external integration. To contribute to closing of this gap, study 2 was conducted to develop a *context based framework for evaluation of external integration*. Finally, the subsequent study 3 aimed to develop a *framework for evaluation of the S&OP process*.

Concerning the SCI challenges, this research contributes to previous integration literature by confirming some existing challenges but also by identifying additional challenges. Related to challenges of external integration, a set of contextual factors are identified which were observed to challenge the establishment of an appropriate level of external integration with SC partners. As a result a misfit occurs between the contextual factors and applied level of external integration. Additionally, reasons for the misfits were identified and discussed.

Associated with the challenges of S&OP process, this thesis adds to existing fragmented literature on the S&OP process evaluation challenges by synthesizing and extending the existing knowledge. A framework has been developed which is founded on two key areas of process performance – S&OP process effectiveness and efficiency, and on various maturity levels of the process. Although several challenges were found for each maturity level, some challenges were observed occurring across more levels.

Moreover, in this research, a context based framework for evaluation of external integration is proposed. The framework extends the previous SCI frameworks. It is founded on contextual factors which were considered by the studied cases when integrating with their SC partners. Furthermore, the factors were observed to promote establishment of an appropriate level of external integration. Each level consists of identified external integration activities.

The thesis further contributes to the S&OP performance research by addressing the lack of process oriented frameworks for evaluation of the process performance. The proposed framework of measuring the S&OP process performance considers the five major steps of the process and their outputs as well as the output of the entire process. To reflect the process performance measures, the framework structures and defines effectiveness and efficiency measures and their relation to the process performance. The framework also conforms to the majority of the criteria for designing of appropriate performance measures.

Finally, the major results of the thesis are synthesized and a framework is suggested of external integration and its effect on S&OP process performance. The framework considers the identified contextual factors, appropriate levels of external integration, and the S&OP performance measures the integration can have effect on.

The thesis also discusses, alongside with the theoretical contributions, how the developed frameworks can support managers in evaluating their supply chain integration practices. Additionally, several opportunities for future research are outlined.

Sammanfattning

Fördelarna med att implementera integration i försörjningskedjor nämns i existerande litteratur. Integration som sträcker sig utöver funktionella silor och utom företagets gränser, förväntas skapa olika värden för dess kunder. Detta kan ske i form av högre kvalitet, förbättrad kundservicenivå och/eller minskade kostnader. Dessutom gör intern integration det möjligt att företagets funktioner kan förenas utifrån ett gemensamt mål. Denna typ av integration främjar ett värdeskapande medan kostnader och icke värdeskapande aktiviteter minskar.

Trots viktiga framsteg inom denna forskning och praktik, upplever många företag fortfarande problem med integration av aktiviteter med partners i försörjningskedjor. Svårigheter upplevs även med att integrera aktiviteter internt, som till exempel vid implementering av sälj- och verksamhetsplaneringsprocess (S&OP).

För att ta itu med dessa utmaningar kan företagen behöva se över, varför och hur de integrerar, både internt och externt. Dock ger den existerande forskningen inom området endast en begränsad vägledning för hur en sådan utvärdering skulle kunna genomföras. Många företag upplever problem med att bemöta integrationens egna svårigheter samt med utvärdering av de interna och externa aktiviteter som finns inom olika slags försörjningskedjor. Bristen på en i teorin konkret vägledning, ses som en av anledningarna till att det fortfarande bara finns sporadiska fall av framgångsrik integration.

Det övergripande syftet med denna forskning är därför att öka befintliga kunskaper om extern och intern integration inom försörjningskedjor. För att uppnå detta syfte genomfördes tre studier (1-3). Studie 1, vilken uppmärksammade nuvarande status och ett flertal *utmaningar med integration i försörjningskedjor*, både inom litteraturen och i praktiken. En av de många utmaningar som uppdagats är bristen på ett systematiskt tillvägagångssätt för utvärdering av både intern och extern integration. För att bidra till att bemöta dessa utmaningar utfördes studie 2, med syftet att utveckla *ett kontextbaserat ramverk för utvärdering av extern integration*. Slutligen genomfördes studie 3, vilken syftade till att utveckla *ett ramverk för utvärdering av S&OP processens prestanda*.

Gällande utmaningarna med integration i försörjningskedjor, har denna forskning bidragit till den existerande integrationslitteraturen, genom att bekräfta befintliga utmaningar, men också genom identifieringen av nya utmaningar. Angående utmaningar med extern integration har ett flertal kontextuella faktorer identifierats. Dessa utmanade etableringen av en passande nivå vid extern integration med partners i försörjningskedjor. Som resultat av detta uppstår en avvikelse mellan de kontextuella

faktorerna samt hos den tillämpade nivån av extern integration. Anledningar till dessa avvikelser har också identifierats och diskuterats.

Angående utmaningar med S&OP processen, bidrar denna avhandling till den befintliga fragmenterade litteratur som behandlar utmaningar med utvärdering av S&OP processens prestanda. Detta gjordes genom att syntetisera och vidareutveckla existerande kunskap. Ett ramverk har föreslagits som grundar sig på två huvudområden av processprestanda, S&OP processens yttre och inre effektivitet. Även olika nivåer av processens mognad tas det här hänsyn till. Ett antal utmaningar identifierades för var och en av mognadsnivåerna. Utmaningar typiska för flera nivåer observerades också.

Vidare har ett kontextbaserat ramverk för utvärdering av extern integration föreslagits. Ramverket vidareutvecklar det existerande ramverket. Det bygger på kontextuella faktorer som de studerade företagen tar hänsyn till vid extern integration. Dessa faktorer verkar främja etablering av en passande nivå av extern integration. Varje nivå består av ett antal identifierade aktiviteter av extern integration.

Avhandlingen bidrar vidare till litteratur som behandlar S&OP processens prestanda genom att bemöta bristen på processorienterade ramverk för utvärdering av prestanda. Det föreslagna ramverket tar hänsyn till de fem huvudsteg inom processen, deras resultat samt resultaten av hela processen. Ramverket strukturerar och definierar mått av processens yttre och inre effektivitet samt deras relation till processens prestanda. Ramverket uppfyller också majoriteten av kriterier för utformning av prestandamått.

Slutligen har de viktigaste resultaten av avhandlingen syntetiserats och ett ramverk föreslagits för extern integration och dess effekt på S&OP processens prestanda. Ramverket bygger på de identifierade kontextuella faktorer, dess passande nivåer av extern integration och integrationens potentiella påverkan på S&OP processens prestandamått.

I avhandlingen diskuteras utöver de teoretiska bidragen, också hur de utvecklade ramverken kan stödja företag i deras utvärdering av integration i försörjningskedjor. Därutöver presenteras ett antal förslag för framtida studier.

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Appended papers

- P1: Näslund, D., and Hulthen, H. (2012). "Supply chain management integration: a critical analysis." *Benchmarking: An International Journal* Vol. 19, No 4/5, pp. 481-501. (Highly Commended Paper Award 2013 in Emerald Literari Network)
- P2: Hulthén, H. "A Grounded Theory based study of contextual factors and their effect on external integration in supply chains." (Under review in *International Journal of Logistics Management*)
- P3: Hulthén, H. and Pazirandeh, A. "Reasons for limited integration in highly interdependent buyer-supplier relationships: Insights from two cases." (Under review in *Journal of Purchasing and Supply Management*)
- P4: Hulthén, H., Naslund, D., and Norrman, A. "Challenges of Measuring the Sales and Operations Planning Process." (Accepted for publication in *Operations and Supply Chain Management: An International Journal*)
- P5: Hulthén, H., Naslund, D., and Norrman, A. (2016). "Framework for Measuring the Performance of the Sales and Operations Planning Process: A Multiple-case Study". *International Journal of Physical Distribution & Logistics Management*, (forthcoming) Vol. 46, No. 9, pp. 1-28.

Related publications

1. Hulthén, H. Kembro, J. Naslund, D. (2011), Intra-organizational communication as an enabler of internal integration, *Proceedings of the 23rd NOFOMA conference*, June, Harstad, Norway.
2. Hulthén, H. (2013), A model of contextual factors and inter-organizational integration: A Grounded Theory study of two supply chains. Licentiate thesis, Lund University, Sweden.
3. Hulthén, H. Pazirandeh, A. (2014), Misfit between inter-organizational integration and business context of interdependent firms: a conceptual framework and case examples, *Proceedings of the 13th EUROMA conference, June, Palermo, Italy*.
4. Hulthén, H., Naslund, D. and Norrman, A. (2015), Challenges of Measuring Performance of the Sales and Operations Planning Process, *Proceedings of the 27th NOFOMA conference*, June, Molde, Norway.

1. Introduction

In this chapter the background to the main themes of the thesis is presented. First the problem is highlighted by discussing Supply Chain Integration and the state of the previous research on the subject. Next, the overall purpose and research objectives of the thesis are formulated. Finally, the scope and structure of the thesis are outlined.

1.1 Background

In today's turbulent world it is particularly important to manage the increasing instability of supply chains (Stevens and Johnson, 2016; Christopher and Holweg, 2011). The instability is caused by several aspects such as information distortion along the supply chain, known as the "bullwhip" effect (Lee et al., 1997), by challenges of demand forecasting and data integrity, advancement in technology leading to development of new business models (Johnson and Mena, 2008), new supply chain strategies (Christopher and Towill, 2002), and by increased distances between a global market and the supply base. These aspects result in the necessity to manage increasingly complex networks.

Considering such a complex business environment, managers are expected to enhance reliability (i.e. deliver right products, right quantity, at the right time and place at the lowest cost), responsiveness (i.e. fast reaction to market changes), productivity and customer service (Hendricks and Singhal, 2008). Shareholders, on the other hand, require increased profitability. Thus, to stay competitive, firms have to offer value to customers while remaining profitable (Ralston, et al., 2015; Leuschner et al., 2013, Danese et al., 2013).

To cope with these challenges, the Supply Chain Management (SCM) concept is widely advocated. SCM has received a considerable amount of attention from scholars and practitioners (Huo, 2012; Grubic et al., 2010; Wong and Boon-itt, 2008). SCM aims to enhance long-term performance of a company as well as of the whole supply chain. Although there are several views on its meaning, in this thesis SCM is seen as implementation of a management philosophy through establishment of management practices such as integrative behavior (Mentzer et al., 2001). It involves systemic and strategic coordination of business functions, in terms of material, information and financial flows, both across the functions within a company and also with supply chain partners.

To attain the coordination it is suggested to increase interaction among as well as within companies in supply chains to ensure effective and efficient flows (Ralston et al., 2015; Leuschner et al., 2013; Flynn et al., 2010;

Lambert and Cooper, 2000). The growing need for this interaction requires supply chain integration¹ which is one of the elements of achieving a demand-driven supply chain that enhances firm performance (Ellinger et al., 2012; 2011).

Supply Chain Integration (SCI) thus represents a tool for attaining SCM (Stevens and Johnson, 2016). SCI is enabled through strategic and operational integration internally across traditional organizational functions (Ellinger, 2000) and externally with suppliers and customers (Swink et al., 2006; Benton and Maloni, 2005).

Despite a vast body of research on SCI (e.g. Flynn et al., 2010; Droge et al., 2004; Vickery et al., 2003; Frohlich and Westbrook, 2001), there is no single accepted definition (Gimenez et al., 2011; Fabbe-Costes and Jahre, 2008; Lummus et al., 2008; Pagell, 2004). Campbell and Sankaran (2005) pointed out that in the literature, there is ambiguity in using terminology associated with SCI, as the term *integration* has been simultaneously used to describe both the goal of SCM as well as the process of connecting with supply chain partners. These inconsistencies lead to considerable confusion regarding the meaning of the concepts, which complicates the research process (Fabbe-Costes and Jahre, 2008).

For the purpose of this thesis, SCI is defined as “*the management of various sets of activities that aims at seamlessly linking relevant business processes both within and across firms*” (Ralston et al., 2015:47).

SCI is a multidimensional concept including governance, organization structure, relationship management, business strategy, process design, and performance management (Stevens and Johnson, 2016). Additionally, previous literature distinguishes upstream and downstream integration (e.g. Droge et al., 2012; Flynn et al., 2010) or customer, supplier, and internal integration (e.g. Wong et al., 2011; Pagell, 2004). One of the most common distinctions is external and internal integration (Kamal and Irani, 2014; Danese et al., 2013; Huo, 2012; Wong et al., 2011; Stank et al., 2001a). This is also the distinction used in this thesis.

¹ Integration represents “the process of attaining close and seamless coordination between several departments, groups, organizations, systems, etc.” (www.businessdictionary.com; 2015-12-07). In the SCM context it refers to “a comprehensive, system-wide view of the entire supply chain as a single a process, from raw materials supply through finished goods distribution. All functions that make up the supply chain are managed as a single entity, rather than managing individual functions separately.” (CSCMP’s SCM terms and glossary, 2013, www.cscmp.org, 2015-12-07).

External integration relates to the extent to which a company establishes collaborative relationships, shares information and coordinates external integration activities with both suppliers and customers (Gunasekaran, 2004; Narasimhan and Kim, 2001). The external integration activities can be grouped into three dimensions: *coordination of activity links*, *resource ties*, and *actors' bonds through interaction among individuals* (Gadde and Snehota, 2000). The actors involved in the activities include three autonomous firms (a focal company's integration with both customers and suppliers) and represent thus the supply chain (following the supply chain definition by Mentzer et al., 2001).

Coordination of activity links relates to the SC partners' willingness to make investments in mutual tangible and intangible assets (e.g. delivery and sourcing systems, knowledge sharing) (Boon-itt and Wong, 2011; Min et al., 2007; Power, 2005). Resource ties include activities such as joint development of customer products and production processes (Boon-itt and Wong, 2011) and assistance in process improvements (Zhao et al., 2011; Power, 2005). The actors' bonds dimension refers to more interdependent decisions, commitment, trust and adaptation between SC partners (Richey et al., 2009; Bagchi and Skjoett-Larsen, 2002).

Internal integration is the extent to which business functions work cooperatively and interact through cross-functional process integration to resolve conflicts and achieve mutual goals (Danese et al., 2013; Pagell, 2004). Although there are several key internal processes (e.g. Croxton et al., 2001), in recent years the Sales and Operations Planning (S&OP) process has received increased attention both from practitioners and from scholars.

The S&OP process is defined as a medium and long-term planning process aiming to balance demand and supply through synchronization of functional organizational plans (e.g. customers, sales, marketing, new products development, manufacturing, sourcing and financial) into an integrated set of tactical plans (Wagner et al., 2014; Thomé et al., 2012a; Grimson and Pyke, 2007; Lapede, 2004a). S&OP can also be described as a cross-functional process with five major steps: (1) data gathering, (2) demand planning, (3) supply planning, (4) pre-meeting, and (5) executive meeting (Ivert et al., 2015; Wagner et al., 2014; Jacobs et al., 2011; Oliva and Watson, 2011; Ellinger, 2000; Kahn and Mentzer, 1998).

The link between external and internal integration has been frequently debated in SCI literature. There seem to be various views on the relationship. One group of authors argue that when internal integration is preceded by external integration it has a positive effect on business performance of individual firms within a supply chain in terms of enhanced product/service offerings, growth and profitability (Min and

Mentzer, 2004; Croxton et al., 2001; Stevens, 1989). Yet other authors mean that, although internal integration is essential for external integration, external integration can represent an incentive to pursue internal integration. In other words, the external integration demonstrated by interaction with suppliers and customers can stimulate internal integration (Halldórsson et al., 2008; Rodrigues et al., 2004). On the other hand, Richey et al. (2010) suggest focusing simultaneously on external and internal integration as they are interlinked. This view corresponds to Stank et al. (2001b) in that the best practice firms work simultaneously with external and internal integration.

1.2 Problem discussion

Benefits of implementing SCI are extensively acknowledged in existing integration literature (Kannan and Tan, 2010; Arlbjorn et al., 2007; van Donk and van der Vaart, 2004; Rodrigues et al., 2004; Frohlich and Westbrook, 2001). Integration that extends beyond functional silos and firm boundaries provides value for customers in terms of higher quality, enhanced service level and lower costs (Ralston et al., 2015; Wong et al., 2011). While external integration is associated with enhanced customer service, innovation, and new product development (Koufteros et al., 2005; Vickery et al., 2003), internal integration in general, and the S&OP process in particular, allows aligning business functions around a single company goal (Thomé et al., 2012a; Skinner, 1969). Internal integration may also reduce the creation of ‘pockets of power’ that negatively affect other functions (Bowersox et al., 2000) and promote value creation while decreasing redundancies and costs (Ralston et al., 2015; Mollenkopf et al., 2011).

1.2.1 Challenges

Yet, regardless of the significant advances in research and practice, many organizations experience difficulties not only in integrating activities with supply chain (SC) partners (Schoenherr and Swink, 2012; Grubic et al., 2010; Trkman et al., 2007; Simatupang and Sridharan, 2005a; Fawcett and Magnan, 2002), but they also find it difficult to integrate activities within an organization (Ralston et al., 2015; Cook et al., 2011). Related to external integration, Fawcett et al. (2015) identified a set of relational resistors to integration such as territoriality (i.e. exchanging partners protect local, immediate goals and thus sacrifice value creation), strategic misalignment between actors, poor information system connectivity, low trust, unwillingness to share information, resistance to change, poor process integration, leadership deficit, and collaborative skill gap.

Concerning internal integration, Richey et al., (2010) discuss implementation barriers such as unidirectional information flow, functional goals incongruence, and lacking customer orientation. This is particularly relevant even for the S&OP process (e.g. Bower, 2005). Moreover, to integrate without having a clear focus can negatively impact performance (Springinkle and Wallenburg, 2012). It can be argued that the deficiencies in either of the integration types can influence negatively both individual firm performance as well as the overall performance of a supply chain. Therefore, Ralston et al. (2015) emphasize that organizations may need to reconsider why and how they integrate externally and internally.

1.2.2 Evaluation

Simatupang and Sridharam (2005b) concluded that integration requires instruments for evaluation of not only external integration practices but also of internal integration. The aim is to detect shortcomings of the current level of integration and to propose possible initiatives to improve the situation.

However, as several authors stressed, many organizations experience difficulties in addressing the complexity related to evaluation of integration with SC partners as well as internally within an organization (Fawcett et al., 2015; Cook et al., 2011, Danese, 2011). The previous SCI research provides only limited guidelines for the evaluation (Zhao et al., 2013; Flynn et al., 2010; Koufteros et al., 2007; Power, 2005; Bowersox et al., 1999). Some authors mean that the lack of standardized approaches for evaluation of external and internal integration is one of the reasons for deficiencies in integration in practice (e.g. Danese, 2011; Mortensen and Lemoine, 2008; Lummus et al., 2008).

Regarding *external integration*, several authors have emphasized a need to increase understanding about organizational context and essential circumstances for integration with SC partners (e.g. Wong et al., 2015; van der Vaart et al., 2012). Fawcett et al. (2015: 18) concluded that only a few companies managed their integration (i.e. intensity of integration) with suppliers and customers according to the principle that “not all relationships are created equal”. Many firms have invested valuable resources in relationships with a low value co-creation potential which resulted in poor return on investment. The reasons stressed by the managers were lack of skills to identify “the right partner and to build the right relationships with them”. Moreover, many integrative relationships with SC partners are primarily driven by a desire to manage volume and costs rather than to see potential in strategic growth.

There are several levels of intensity of external integration discussed in literature. Spekman et al. (1998) identified four levels including arm's length relationships, cooperation, coordination, and collaboration. Lambert et al. (1996) suggested other terms such as low, medium, and high level of external integration.

According to structural contingency theory (e.g. Donaldson, 2001; Lorsch and Lawrence, 1972; Thompson, 1967), the level (i.e. intensity) of external integration depends on several contextual factors. These factors represent internal and external organizational contexts (Wong et al., 2015; van der Vaart et al., 2012; van Donk and van der Vaart, 2005) with regard to organizational, customer, supplier, competitor, socio-political and technological aspects (Duncan, 1972).

In previous SCI research, several widely recognized context based frameworks exist of external integration (frameworks by e.g. Christopher et al., 2006; van Donk and van der Vaart, 2005; Lee, 2000; Fisher, 1997; Kraljic, 1983). However, the conceptual vagueness of SCI contributed to increased fragmentation of the concept and to the existence of the multiple frameworks that often overlap (Frankel et al., 2008). Also, the frameworks are rather generic in discussing their impact on the level of external integration in terms of specific integration activities with both suppliers and customers. Another issue stressed by several authors (e.g. Näslund and Hulthen, 2012; Jayaram et al., 2010; Fabbe-Costes and Jahre, 2008) is that in previous external integration research, the focus has been mostly on studying integration from a single firm perspective or a dyadic relationship, while studies reaching beyond dyads are rare.

Therefore, development of a framework has been advocated to increase understanding of which contextual factors enable and hinder external integration (Zhao et al., 2013) and how the contextual factors affect selection of particular integration activities and their various characteristics (Danese, 2011). The development of such a framework would increase knowledge of circumstances for external integration, and it would assist managers in evaluating integration with their customers and suppliers (e.g. Schoenherr and Swink, 2012; Fabbe-Costes and Jahre, 2007).

Related to *internal integration*, the S&OP process also suffers from absence of standardized evaluation approaches. Although the process was introduced more than two decades ago (Ling and Goddard, 1988), the related literature and practice still face several issues, one of them being the evaluation of the S&OP process performance (Thomé et al., 2012a).

The current S&OP literature does not offer a standardized process-oriented approach to evaluating the S&OP performance (e.g. Thomé et al., 2012a;

Ivert and Jonsson, 2010; Grimson and Pyke, 2007). The development of such an approach is complicated by the fact that there is no clear definition of the S&OP process performance concept. Additionally, while previous S&OP research does discuss a large number of measures, they are fragmented (e.g. Tuomikangas and Kaipia, 2014; Thomé et al., 2012a; Cecere et al., 2009; Grimson and Pyke, 2007), and they are mainly designed to measure performance of the individual business functions (e.g. sales, production, and finance) rather than the process itself (e.g. Tuomikangas and Kaipia, 2014; Thomé et al., 2012a; Baumann and Andraski, 2010; Keal and Hebert, 2010).

The challenges of measuring performance of the process are more frequently addressed in practitioners' articles (e.g. Lapide, 2005; Bower, 2005) and consultancy reports (e.g. Aberdeen Group 2009, 2004; Cecere et al., 2009), rather than in academic literature. Thus, there is need for more research to increase understanding of the challenges through in-depth, empirically-based studies to design a process-oriented, standardized and comprehensive approach for evaluation of the S&OP process performance.

1.3 Purpose and research objectives

Based on the previous discussion, the overall purpose here is to *increase understanding of external and internal integration in supply chains, focusing on challenges and evaluation.*

To achieve this purpose, the following three research objectives were formulated.

RO1: *To identify challenges of Supply Chain Integration.*

RO2: *To propose a context-based framework for evaluation of external integration.*

RO3: *To propose a framework for performance evaluation of the Sales and Operations Planning (S&OP) process.*

1.4 Scope of the research

The first research objective addresses both internal and external integration, the second focuses on external integration (i.e. beyond dyads), whereas the third considers internal integration, focusing on the Sales and Operations Planning (S&OP) process (see Table 1).

Table 1 Research objectives and studied scope of SCI

Research objectives	Studied scope of SCI
RO1	Internal and external integration
RO2	External integration
	Beyond dyadic integration (First-tier supplier; focal company; first-tier customer)
RO3	Internal integration
	Sales and Operations Planning (S&OP) process

1.4.1 Evaluation of external and internal integration

Several authors have emphasized that one of the prerequisites for attaining an adequate external and internal integration is to evaluate it. Evaluation is defined as the process “...to determine or assess the value or condition of someone or something” (New Webster’s Dictionary, 1992). By doing so, deficiencies in the present integration can be detected and corrective actions formulated to enhance the situation (e.g. Ralston et al., 2015; Simatupang and Sridharam, 2005b).

In this thesis, the aim of the *evaluation of external integration* is to propose a context-based framework founded on the major contextual factors considered by organizations and the corresponding integration activities applied with SC partners (see Figure 1).

To *evaluate the performance of the S&OP process*, the goal is to propose a process-based framework founded on a variety of measures to assess the individual activities (i.e. steps) involved in the process, their outputs as well as the output of the entire process.

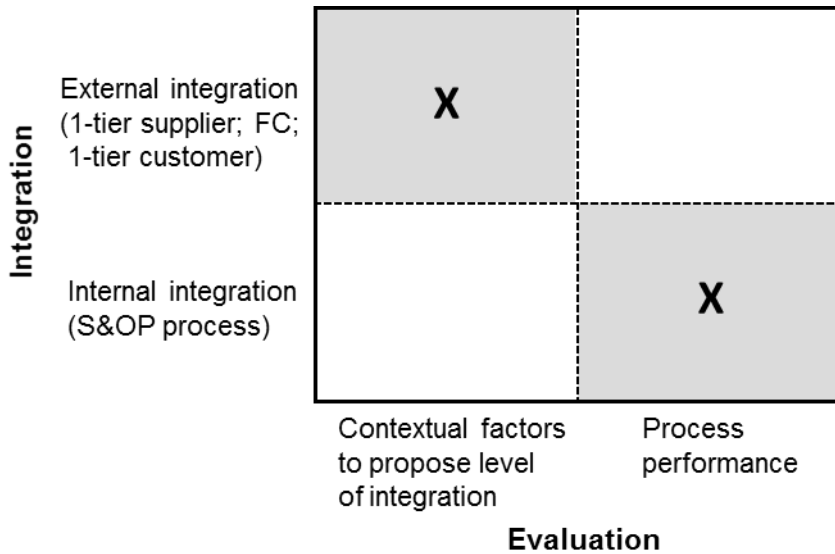


Figure 1 Scope of evaluation of external and internal integration in this research

1.5 Linking research objectives with studies and publications

The examination of the research objectives presented above, conducted in three studies, resulted in five papers (see Table 2).

Study 1 relates to paper 1 (P1) and RO1 and it is a literature review. The RO1 was further addressed in the subsequent Studies 2 and 3. The challenges of external integration were also addressed in paper 2 (P2) and 3 (P3). Paper 4 (P4) based on six cases examined challenges of evaluating the S&OP process. Regarding RO2, Study 2 of two supply chains, reported in paper 2 (P2), focused on evaluation of external integration (i.e. beyond dyads) in relation to the context. Associated with RO3, the evaluation of the S&OP process performance was then addressed through Study 3 with five cases in paper 5 (P5). The list of the articles² is as follows:

² The author of this dissertation has been fully involved in all stages of the studies and articles presented in this dissertation. In the list of articles, “coauthored” refers to papers where both authors were involved in the research process and writing (P1); “first author” relates to papers where the main research work and main part of the writing was conducted by the author (P2, P3, P4, and P5).

- P1: Näslund, D., and Hulthen, H. (2012). "Supply chain management integration: a critical analysis." *Benchmarking: An International Journal* Vol. 19, No 4/5, pp. 481-501. (coauthored)
- P2: Hulthén, H. "A Grounded Theory based study of contextual factors and their effect on external integration in supply chains." (Under review in *International Journal of Logistics Management*) (single author)
- P3: Hulthén, H. and Pazirandeh, A. "Reasons for limited integration in highly interdependent buyer-supplier relationships: Insights from two cases." (under review in *Journal of Purchasing and Supply Management*) (first author)
- P4: Hulthén, H., Naslund, D., and Norrman, A. "Challenges of Measuring the Sales and Operations Planning Process." (Accepted for publication in *Operations and Supply Chain Management: An International Journal*) (first author)
- P5: Hulthén, H., Naslund, D., and Norrman, A. (2016). "Framework for Measuring the Performance of the Sales and Operations Planning Process: A Multiple-case Study". *International Journal of Physical Distribution & Logistics Management*, forthcoming Vol. 46, No. 9, pp. 1-28. (first author)

Table 2 Linking research objectives with studies and publications

RO	Description	Study 1	Study 2		Study 3	
		P1	P2	P3	P4	P5
1.	To identify challenges of Supply Chain Integration.	X	X	X	X	
2.	To propose a context-based framework for evaluation of external integration.		X			
3.	To propose a framework for performance evaluation of the Sales and Operations Planning (S&OP) process.					X

1.6 Structure of the thesis

Chapter 1: Introduction

This chapter provides the background to the main concepts of the dissertation and discusses the current state of the previous research on the main topic. The overall purpose, research objectives and scope of the study are outlined.

Chapter 2: Frame of reference

This chapter presents the theoretical foundation of the main concept of Supply Chain Integration in general and of evaluation of external integration and the S&OP process in particular.

Chapter 3: Research design and methodology

The methodology chapter starts with discussing the author's scientific reasoning in terms of her ontological and epistemological position. Then, the overall structure and research design in this dissertation is discussed, as well as a description of the applied methodological approaches.

Chapter 4: Summary of appended papers

In this chapter, the purpose of each of the five papers and their main contributions are presented.

Chapter 5: Results

In the fifth chapter, the answers to the research objectives of the dissertation are presented.

Chapter 6: Conclusions, contributions and future research

In the final chapter, a concluding discussion is presented alongside theoretical and managerial contributions. Finally, future research opportunities are outlined and discussed.

2. Frame of reference

This chapter starts with defining Supply Chain Integration and it presents various perspectives discussed in related literature. After that, external integration is elaborated on in terms of external integration activities and challenges, as well as the context and its effect on integration with supply chain partners. Existing evaluation frameworks for external integration are addressed. Next, the sales and operations planning process is presented including involved activities and the challenges of evaluating the process performance. Finally, an initial framework for the process performance evaluation is presented.

2.1 Defining Supply Chain Integration

Supply Chain Integration (SCI) is considered to be a wide-ranging concept applied to various links among functions within an organization but also among firms (Chen et al., 2009; Stevens, 1989). There is a common consensus among researchers that due to the complex global business environment it is of a strategic importance for organizations to integrate activities both externally and internally (Danese et al., 2013; Vickery et al., 2003). In previous literature, SCI is associated with three major aspects such as *scope of integration*, *areas to integrate*, and *level of relationship* (Näslund and Hulthen, 2012).

2.1.1 Scope of integration

Two of the most commonly discussed types of scopes of integration are *external integration* and *internal integration* (Kamal and Irani, 2014; Danese et al., 2013; Huo, 2012; Wong et al., 2011; Stank et al., 2001a).

Related to the external integration, the previous literature recognizes two directions of integration: downstream integration (also known as forward integration) with customers (Trent and Monczka, 1998) and upstream integration with suppliers (also known as backward integration) (Fawcett and Magnan, 2002). Despite of the benefits acknowledged by several authors (Kannan and Tan, 2010; van der Vaart and van Donk, 2008; Rodrigues et al., 2004; Frohlich and Westbrook, 2001) that including several tiers into the integrative relationships has a positive effect on performance of all involved parts (i.e. enhanced quality and service level, lower costs) (Ralston et al., 2015; Wong et al., 2011), in reality the dyadic relationships are the most prevailing (Childerhouse et al., 2011; Jayaram et al., 2010; Kempainen and Vepsäläinen, 2003).

Moreover, the external and internal integration are also conceptualized in terms of various stages of integration. Stevens (1989) defines four stages. Stage 1 is characterized by functional independence typical for organizations that delegates responsibilities to separate functions. In stage 2, functional integration emerges but only limited to inbound goods flows. While in stage 3, the organizations understand that the integration of only inbound flows is insufficient and it needs to be extended towards the customer. Finally, in stage 4, the integration encompasses both suppliers and customers and the focus shifts to become customer-oriented rather than just product-oriented. Additional multistage models are discussed by other authors (e.g. Jüttner et al., 2010; Sabath and Whipple, 2004; Sundaram and Mehta, 2002).

2.1.2 Areas to integrate

Areas to integrate covered in previous SCI literature refers to, for example, what to integrate and with whom to integrate. Fabbe-Costes and Jahre (2007) identified four areas: 1) flows (physical, information, financial), 2) processes and activities, 3) technologies and systems, and 4) integration of actors (structures and organizations). Barber (2008) concluded that integration of both tangible and intangible areas needs to be integrated (i.e. processes, procedures, information, knowledge, innovations, and strategies).

According to Lambert et al. (1998), it is vital to identify key processes to be linked with suppliers and customers. To integrate with all supply chain partners is not feasible and economically justifiable. Thus, firms typically segment their external relations and develop collaborative relationships with some supply chains partners while they keep arm's length with others (Lummus et al., 2008; Gimenez and Ventura, 2005; Cox, 2004).

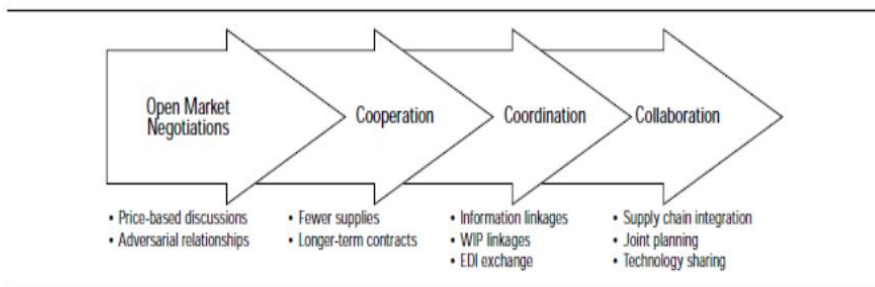
2.1.3 Level of relationship

The level of internal integration starts with a baseline of functional silos with independent functions. In the next level the independent silos are cross-functionally integrated through processes. As a result, the internal integration is moved to full integration involving seamless flow across organizational functions. Then, the integration embrace suppliers and customers, referred to as external integration (Stevens, 1989).

Concerning the external integration, not all business relationships with SC partners should be collaborative, and it is acceptable to be involved in an arm's-length relationship if such behavior is appropriate (Gimenez and Ventura, 2005; Spekman et al., 1998; Lambert et al., 1998; Kraljic, 1983). The level of external integration may vary from arm's length ones to

collaboration and strategic alliances. Spekman et al. (1998) differentiate between four levels of external integration: open market negotiations, cooperation, coordination and collaboration (see Figure 2).

The *open market negotiations*, also known as Arm's length relationships, represent a pure exchange type of relationship between supply chain members. There are no joint commitments or operations which mean that the relationship is terminated when the exchange ends (Shah et al., 2002). In a *cooperation* type of relationship, the emphasis is put on information sharing or assets sharing between SC partners and identifying areas of joint interest (Power, 2005). It is an initial step towards demand synchronization and cross-functional interaction, involvement of relevant parties, clear understanding of responsibilities (Ajmera and Cook, 2009).



(Spekman et al., 1998:57)

Figure 2 Transition from open-market negotiations to collaboration

Coordination, on the other hand, requires SC members to work jointly to achieve materials and information flows efficiency across the supply chain through aligned decision making to attain the overall supply chain objectives (Sahin and Robinson, 2002). The highest level of relationship refers to *collaboration*. It engages reciprocal relationships in which both partners possess equal power to avoid forced solutions by the other part (Ho et al., 2002). Typically, it involves joint planning and performing of activities such as logistics, product development and strategic planning (Ajmera and Cook, 2009).

2.1.4 Challenges of Supply Chain Integration

Previous literature pointed out the “conceptual vagueness” of SCI (Fabbe-Costes and Jahre, 2008; Pagell, 2004). Although, the concept is far from being new (e.g. Stevens, 1989) a single accepted definition is still missing

(Gimenez et al., 2011; Lummus et al., 2008). The concept has been perceived as synonymous with SC collaboration (e.g. Simatupang and Sridharan, 2005a; Sahin and Robinson, 2005; Handfield and Nichols, 1999) or that SC collaboration and coordination represent elements of SCI (Leuschner et al., 2013). This leaves us with ambiguity as to what constitute SCI which has negative impact on conducting research on this topic (Autry et al., 2014; Fabbe-Costes and Jahre, 2008). Moreover, according to several authors, SCI is “*more a rhetoric than reality in most industries...*” (Bagchi et al., 2005, p. 288) and total “*end-to-end*” seamless integration is difficult to achieve in practice (Grubic et al., 2010; Trkman et al., 2007).

Thus, in order to suggest corrective actions, instruments for evaluation of integration are needed (Simatupang and Sridharam, 2005b). However, several authors reported that existing SCI literature lacks standardized approaches for the evaluation of external and the S&OP process (Zhao et al., 2013; Flynn et al., 2010; Bowersox et al., 1999; Thomé et al., 2012a).

2.2 Evaluation of external integration

External integration in this thesis is defined as the management of inter-organizational relationships of autonomous firms. The scope encompasses a focal company and its integration with both customers and suppliers (Mentzer et al., 2001). Håkansson and Snehota (1995: 26) define a relationship between two organizations as “*...a result of an interaction process where connections have been developed between two parties that produce mutual orientation and commitment.*” Additionally, three major dimensions are distinguished which constitute such relationship: Activity links, Resource ties and Actors bonds. The nature of the relationship can be thus described by the dimensions and their relative importance in a particular relationship (ibid).

This view closely corresponds to the main characteristics of external integration discussed in SCI literature emphasizing, among others, the interaction process and mutual orientation (e.g. Flynn et al., 2010; Romano, 2003; Cooper et al., 1997). Furthermore, three dimensions are considered to be relevant for operationalizing external integration. In order to implement and maintain external integration it is vital to coordinate and manage them. Integration activities included in these dimensions are referred to as external integration activities (see Table 3).

Coordination of activity links relates to SC partners’ willingness to make investments in mutual tangible and intangible assets. It includes activities, for example, delivery and sourcing systems (e.g. just-in-time, EDI), resources committed to learning the other partner’s practices and

routines, and risk and reward sharing (Min et al., 2007), multiple functional interfaces (Dyer et al., 1998), IT systems implementation (e.g. ERP, EDI, VMI) (Richey et al., 2009; Koufteros et al., 2007), information sharing with key actors (e.g. production schedule, plans, capacity, inventory, demand forecasts and performance) (Boon-itt and Wong, 2011; Power, 2005), and knowledge and assets sharing (Lamming et al., 2000; Dyer et al., 1998).

Table 3 Dimensions of external integration

Dimensions of external integration	Examples of external integration activities	Reference
Coordination of activity links	<ul style="list-style-type: none"> • Coordination actions taken by partners to gain mutual or singular outcomes but with expected reciprocity • Partners' willingness to invest to distinctive tangible and intangible assets • Equal sharing of risk and reward • Formal and informal exchange of timely and relevant information 	Gadde and Snehota (2000); de Ruyter et al., (2001); Buchanan (1992); Gundlach and Cadotte (1994); Gulati and Sytch (2007)
Resource ties	<ul style="list-style-type: none"> • Joint development of buyer specific products and manufacturing processes 	Gadde and Snehota (2000); Wagner and Johnson, (2004)
Actors bonds	<ul style="list-style-type: none"> • Close interaction of representatives from supplier and buyer organization • Commitment as a desire to maintain a valuable relationship with a trade partner • Trust founded on inter-organizational adaptation and learning 	Gadde and Snehota (2000); Liu et al., (2010), Geyskens et al., (1996)

Resource ties consist of integration activities such as joint development of customer products and production processes (Boon-itt and Wong, 2011) as well as assistance in process improvements (Zhao et al., 2011; Power, 2005).

The *actors bonds* dimension which considers close interaction of customers and suppliers leading to more interdependent decisions, commitment, trust and adaptation which are importance aspects of integration (Gadde and Snehota, 2000). It involves multiple contact points at all management levels (Richey et al., 2009; Bagchi and Skjoett-Larsen, 2002), and cross-functional teams across organizations (Richey et al., 2009) to encourage close interaction of representatives from suppliers and customers.

2.2.1 Challenges of external integration

Previous integration research concluded that the preferable level of external integration with SC partners depends on several situational factors representing context. It is associated with a focal company, industry, competitive environment, and nature and type of products (Wong et al., 2015; van der Vaart et al., 2012; van Donk and van der Vaart, 2005; Bagchi and Skjoett-Larsen, 2002). Yet, existing literature needs to be further developed in terms of what contextual factors enables or inhibit external integration (Zhao et al., 2013) and how the contextual factors influence the selection of specific external integration activities and their various characteristics Danese (2011).

Many organizations see as problematic to understand the complexity associated with integration with SC partners (Cook et al., 2011). As pointed out by, for example, van Donk and van der Vaart (2005), the previous research offers rather limited insight into context and its effect on level of external integration. In this dissertation, context is referred to as “...*the setting in which organizational practices are established and applied.*” (Ho et al., 2002:4424). There is a common agreement among researchers that level of external integration depends on contextual factors (Wong et al., 2015; van der Vaart et al., 2012; van Donk and van der Vaart, 2005; Ho et al., 2002; Bagchi and Skjoett-Larsen, 2002; Lambert et al., 1996).

2.2.2 Contextual factors and the effect on level of external integration

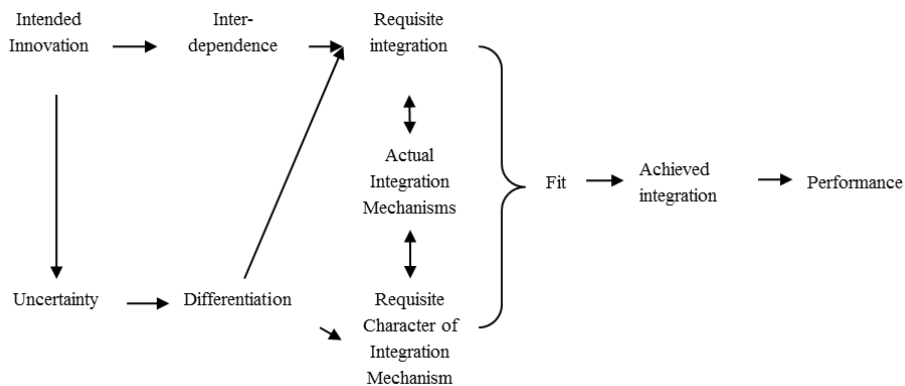
Structural contingency theory

The assumption of the classical structural contingency theory (SCT) (e.g. Donaldson, 2001; Lorsch and Lawrence, 1972; Thompson, 1967), taking the internal integration perspective, is that in order to determine a requisite level of integration, factors associated with an organization’s external and internal context should be scrutinized. Organizations are encouraged to match contextual factors representing organizational context with an appropriate level of external integration to maximize organizational performance. In other words, an organization that experiences misfit between contextual factors and level of external integration becomes ineffective (Donaldson, 2001).

Prior to defining contextual factors, the meaning of organizational context needs to be outlined. Relying on Duncan’s (1972) definition, context is seen as physical and social factors directly considered in the decision-making of individuals in the organization. While contextual factors refer to “...*factors within the boundaries of the organization or specific decision making*”

units” that need to be considered as part of the organizational context (Duncan, 1972:314). The author differentiates between an internal and external context. The internal context includes contextual factors which are within the boundaries of the organization. The factors are related to organizational personnel, organizational functional and staff units, and organizational level. The external context considers contextual factors outside the boundaries of the organization such as customer, supplier, competitor, socio-political, and technological (Duncan, 1972).

A stream of the SCT that discusses integration and is thus pertinent for this dissertation has its origin in examining internal cross-functional integration. (e.g. Lorsch and Allen, 1973; Lawrence and Lorsch, 1967; Thompson, 1967). Donaldson (2001) developed a causal model (see Figure 3) to illustrate that the contextual factor of intended innovation (i.e. novelty rate and number of new products per time unit) affects the level of interdependence between functions. The interdependence is seen as a mediator between the intended innovation and requisite integration. Then, the higher the level of interdependence, the higher the level (i.e. intensity) of integration between the functions is needed to attain a fit and thus enhance performance.



(Donaldson, 2001: 45)

Figure 3 A causal model of interdependence, integration, and differentiation of functional departments

Lorsch and Lawrence (1972) studied effect of rate of innovativeness on integration. The authors concluded that in a low innovative industry the level of interdependence between functions is low which resulted in a low level of integration needed to manage the interaction of the two functions. On the other hand, in a high innovative industry, the level of

interdependence of the function was high and consequently the level of integration between the functions was also high. The fit between the level of contextual factors and level of integration resulted in enhanced performance. In case of deviation between the level of contextual factors and the level of integration between functions, there is a misfit which negatively affects performance.

Thompson (1967) defines three types of interdependence such as pooled, sequential, and reciprocal one. Pooled interdependence is characterized by no direct connection between organizational subunits and it can be managed by rules and procedures. In sequential interdependence, subunits have a direct connection (i.e. the output of one subunit is the input to the other subunit). An effective way of managing it is by planning. Reciprocal interdependence demonstrates two-way connection (i.e. the output of each subunit is the input to the other subunits). This type of interdependence can be effectively managed by mutual adjustment.

Structural contingency theory in external integration research

The contingency theorists not only influenced the research in logistics (e.g. Pfohl and Zöllner, 1997; Persson, 1997) but also SCI research. Several researchers suggested applying this theory when studying external integration to examine interaction between organizations in supply chains as they are systems that are open and thus influenced by their environment (e.g. Danese, 2011; Flynn et al., 2010; Fawcett et al., 2008; Skipper et al., 2008; Stonebraker and Afifi, 2004). While studies by, for example, Danese (2011), Flynn et al. (2010) and Fawcett et al. (2008) use rather limited subset of the SCT such as general statements, work by Skipper et al. (2008) and Stonebraker and Afifi (2004) build on the SCT. Skipper et al. (2008) aim offering a theoretical basis to enhance knowledge of supply chain interdependence and technology-enabled coordination while Stonebraker and Afifi (2004) use relationship between internal differentiation and integration to external supply chain activities. Thompson's view on interdependence in SCT has also been extended beyond organization's boundaries and it was used within supply chain oriented studies (e.g. Bankvall et al., 2010; Dubois et al., 2004; Håkansson and Persson, 2004; Stabell and Fjelstad, 1998).

2.2.3 Fit between contextual factors and level of external integration

According to the SCT, organizations are encouraged to continuously strive to attain fit between context and level of integration to maximize performance (e.g. van der Vaart et al., 2012; Donaldson, 2001). Nevertheless, managers perceive as challenging to exactly identify the *fit* -

denoting what level of integration is required and economically justifiable, taking into consideration the various contextual factors (Donaldson, 2001).

Contextual factors

Drawing on the SCT research, but taking external integration perspectives, additional contextual factors (i.e. beyond the rate of innovativeness) were studied. The factors previously examined in relation to external integration are summarized in Table 4.

As it is apparent from the list, the factors have been often scrutinized in isolation and a more comprehensive view is still lacking. The factors related to *both high and low level of external integration* can be grouped in clusters such as Resource availability, Demand predictability, Strategy, and Type of products. Factors associated with high level of integration can be collapsed into other clusters: Technological change, Environmental change, and Power between SC actors. Related to low level of integration, other previously examined contextual factors can be grouped as Geographical proximity of SC actors, Supplier performance, and Power between SC partners.

To illustrate, major factors requiring a high level of integration (to attain fit) are High technological uncertainty (Boon-itt and Wong, 2011), High unpredictability and uncertainty of demand (Childerhouse et al., 2011; Danese, 2011), Strategic importance, Complexity, Innovativeness of products (Dyer et al., 1998). Factors leading to low level of external integration are Low uncertainty and Longer planning scope (Kemppainen and Vepsäläinen, 2003), Standardized and Functional type of products/components (Dyer et al., 1998), and Consistency in supply and quality (Cooper et al., 1997).

Table 4 Contextual factors and the effect on level of external integration

Contextual factors	Level of external integration	Reference
High level of external integration		
Technological change		
High technological uncertainty	Collaboration	Boon-itt and Wong (2011)
Long-term value creation (quality, new technologies)	Strategic partnership	Dyer et al., (1998)
Product development capabilities	Supplier integration	Koufteros et al., (2007)
Environmental change		
Environmental turbulence	Higher	Stonebraker and Liao (2004)
Complex, rapidly changing SCM environment	Cooperation	Power (2005)
Resource availability		
Scarcity of resources	Strategic partnership	Dyer et al., (1998)
Demand predictability		
Unpredictable market demand	Close coordination, Collaboration	Danese (2011), Lee (2000)
Low uncertainty in volume, high uncertainty in mix/specification; high uncertainty in volume, high uncertainty in mix/specification	High level	van Donk and van der Vaart (2005)
Strategy		
Strategy (total cost reduction, differentiation)	Collaboration	Koufteros et al., (2007)
Type of products		
High strategic nature of input	Close cooperation	Zhao et al., (2011); Power (2005); Kraljic (1983)
Innovative, unique products with higher/lower complexity	Very close relationship	Lamming et al., (2000); Fisher (1997)
Complex-product industries	Strategic partnership	Dyer et al., (1998)
Shorter product life cycle	High integration	Zhao et al., (2011)
Power between SC actors		
Interdependence, as a result of power and leverage situation between buyer and supplier, buyer dominance over supplier	Supplier integration	Koufteros et al., (2007)
Low level of external integration		
Resource availability		
Excess of suppliers capacity	Arm's length relationship	Dyer et al., (1998)
Strategy		
Proactive strategy (prospector)	Less integrative efforts	Stonebraker and Liao (2004)
Short-term cost reduction	Arm's length relationship	Dyer et al., (1998)
Demand predictability		
Low uncertainty in volume and low uncertainty in mix/specification; High uncertainty in volume and low uncertainty in mix/specification	Absent need for integration or less integration	van Donk and van der Vaart (2005); Lee (2000)
Geographical proximity		
Distance channel position of SC members	Arm's length relationship	Cooper et al., (1997); Lee et al., (1997)

Supplier performance		
Consistent suppliers quality/ service abilities	Arm's length relationship	Cooper et al., (1997)
Type of products		
Standardized products	Arm's length relationship	Dyer et al., (1998); Zhao et al., (2011)
Longer PLC	Less integration	Zhao et al., (2011)
Functional products – higher complexity/lower complexity	Less integration	Lamming et al., (2000); Fisher (1997)
Power between SC actors		
Downstream channel power	Lower level	Richey et al., (2009)

Additionally, a level of external integration differs with various SC partners. Selectivity is advocated in determining what level of integration (i.e. intensity of integration) to establish with suppliers and customers (Lambert et al., 2005).

Level of external integration

Level of external integration refers to the intensity of the three dimensions discussed above: coordination of activity links, resource ties, and actors bonds. In previous integration literature several terms and operationalization of various levels are presented (Leuschner et al., 2013). The drawback is that the terms are used interchangeably as they overlap in their meaning which contributes the conceptual ambiguity of the integration literature (Leuschner et al., 2013; Danese, 2011; Fabbe-Costes and Jahre, 2008; Pagell, 2004).

Alongside with Spekman's et al., (1998) four levels of external integration, as discussed above, there are many other often overlapping terms used when referring to high or low level of integration, as presented in Table 5. High level of external integration is also referred to as higher degree of integration (e.g. Richey et al., 2009), close coordination (Childerhouse et al., 2011), close cooperation (e.g. Zhao et al., 2011) or very close relationship (Lamming et al., 2000). Associated with low level of external integration, the major synonymous term applied is an arm's length relationship (e.g. Bagchi and Skjoett-Larsen, 2002). Considering the integration activities, they comprise of large number of areas such as related to information and organizational aspects.

Table 5 Levels of external integration and related integration activities

Level of external integration	Dimensions of external integration activities			Reference
	Coordination of activity links	Resource ties	Actors bonds	
<i>High level of external integration</i>				
<i>Cooperation</i>	<ul style="list-style-type: none"> - Sharing of information/assets - Technology implementation 		<ul style="list-style-type: none"> - Sharing of areas of common interest; trust, interdependence 	Power (2005)
<i>Close cooperation</i>	<ul style="list-style-type: none"> - IT with major customers for ordering - Information sharing, communication with major customers and suppliers (production schedule, plans, capacity, inventory, demand forecast) 	<ul style="list-style-type: none"> - Support in process improvement to major supplier - Participation in procurement production, design process 	<ul style="list-style-type: none"> - Regular contacts with major customer (provide feedback) - Strategic partnership with major supplier 	Zhao et al. (2011); Power (2005); Kraljic (1983)
<i>Close coordination</i>	<ul style="list-style-type: none"> - SC process integration 			Childerhouse et al. (2011)
<i>Collaboration</i>	<ul style="list-style-type: none"> - Information sharing with major suppliers through IT - High degree of joint planning 	<ul style="list-style-type: none"> - Suppliers involved in NPD process 		Boon-itt and Wong (2011)
	<ul style="list-style-type: none"> - Share performance results 	<ul style="list-style-type: none"> - Customers input into corporate strategies 	<ul style="list-style-type: none"> - Strategic alliances - Cross-functional teams - Customers/suppliers visits 	Koufteros et al. (2007)
<i>Very close relationship</i>	<ul style="list-style-type: none"> - Sharing of know-how and production technology 			Lamming et al. (2000)
<i>Higher degree of integration</i>	<ul style="list-style-type: none"> - ERP, SC Planning systems EDI/Internet/XML links - Access to production plans, materials requirements, forecasts, orders - CPFR/ VMI/ CRM with key suppliers/customers - Performance data shared 		<ul style="list-style-type: none"> - Multiple contact points at all management levels - Teams across the SC: regular interaction 	Richey et al. (2009); Bagchi and Skjoett-Larsen (2002)
<i>High level</i>	<ul style="list-style-type: none"> - Agree on reservation of capacity - SC planning and control - Information sharing between buyers and suppliers 			Van Donk and van der Vaart (2005)
<i>Operational SC integration</i>	<ul style="list-style-type: none"> - SC reengineering, JIT - Standardized, simplify SC processes - Adjust delivery schedule 			Koufteros et al. (2007)
<i>Implementation of SCM practices</i>		<ul style="list-style-type: none"> - Supplier development 	<ul style="list-style-type: none"> - Long-term operational relationship with extensive and close working with SC actors 	Cox (2004)

Low level of external integration				
<i>Arm's length relationship</i>	<ul style="list-style-type: none"> - E-mail/ Fax/ phone; - Limited use of Internet/ Extranet - Only bar-coding of finished products - Fragmented logistics activities - Measurement of delivery service, inventory levels in some parts of SC 		<ul style="list-style-type: none"> - Few contacts points between companies in SC - No cross-functional teams 	Bagchi and Skjoett-Larsen (2002)
<i>Durable arm's length relationship</i>	<ul style="list-style-type: none"> - Minimal assistance 		<ul style="list-style-type: none"> - Single functional interface (e.g. sales to purchasing) 	Dyer et al. (1998); Zhao et al. (2011)
<i>Necessity to integrate is absent</i>	<ul style="list-style-type: none"> - Simple ordering procedures 			Van Donk and van der Vaart (2005)

Moreover, the majority of external integration activities previously addressed in SCI literature relate to the dimension of coordination of activity links, followed by the actors bonds and resource ties.

High level of external integration

High level of integration relates to integration activities undertaken by trade partners to gain mutual or singular outcomes but with expected reciprocity (de Ruyter et al., 2001). Within the coordination of activity links dimension, high level of integration activities relate to implementation of supply chain IT systems (e.g. ERP, EDI, VMI, SC planning) (Boon-itt and Wong, 2011; Richey et al., 2009; Bagchi and Skjoett-Larsen, 2002), knowledge sharing (e.g. know-how, production technology) (Lamming et al., 2000; Dyer et al., 1998), and information sharing and communication (e.g. production scheduling, plans, capacity, inventory, demand forecasts, performance feedback) (Zhao et al., 2011; Koufteros et al., 2007; Power, 2005).

The resource ties dimension includes integration activities such as suppliers' involvement in new products development (NPD) process (Boon-itt and Wong, 2011), customers' input on, for example, suppliers' procurement, production and design process (Zhao et al., 2011; Power, 2005), and suppliers development programs (Cox, 2004). While the actors bonds dimension is characterized by high level integration activities such as multiple functional interfaces (Richey et al, 2009; Koufteros et al., 2007; Bagchi and Skjoett-Larsen, 2002; Dyer et al., 1998) and long-term operational relationships (Cox, 2004).

Low level of external integration

Low level of external integration refers to arm's length relationship situation when two companies are engaged in business with each other

often over long-period of time. Multiple exchanges are involved. However, there are low levels or even no external integration activities between the companies as there is no joint commitment or joint operations (Lambert et al., 1996).

In such situation, the coordination of the activity links dimension consist of low level integration activities which are, for example, simple ordering procedures (traditional order handling) with very limited or any use of supply chain IT systems and with limited performance feedback offered to SC actors (e.g. on delivery service, inventory) (Bagchi and Skjoett-Larsen, 2002). Additionally, the suppliers' assistance is negligible (Dyer et al. 1998; Zhao et al., 2011). The low level external integration related to the actors bonds dimension includes few contact points between SC actors (Bagchi and Skjoett-Larsen, 2002) with limited functional interfaces (e.g. restricted to contact between customer's sales function and supplier's purchasing) (Zhao et al., 2011; Dyer et al., 1998).

2.2.4 Misfit between contextual factors and level of external integration

Taking the external integration perspective, it is suggested that high interdependence between SC actors is the most favorable situation for external integration and foster closer relationship, higher trust and commitment (Casciaro and Piskorski, 2005; Watson, 2001) and mutual adjustment (Thompson, 1967; Gulati and Singh, 1998; Dyer and Singh, 1998). Several authors suggest that the higher the interdependence the higher the motivations of parties to invest time, efforts, financial resources and to commit to the relationship (e.g. Lusch and Brown, 1996; Grundlach and Cadotte, 1994). High interdependence is favorable for relational behavior (Yilmaz et al., 2005), and long-term orientation in a buyer-supplier relationship defined by investments in assets and risk sharing (Ganesan, 1994).

However, the existing SCI literature argues that high interdependence between SC actors does not always results in high level of external integration (i.e. activities within the three dimensions: coordination of activity links, resource ties, and actors bonds) (Kumar et al., 1995). Likewise, initial power dependency symmetry does not guarantee long-term high level of integration (Narayandas and Rangan, 2004). Caniëls and Gelderman (2007) concluded that interdependent relationships actually exhibit supplier dominance and thus may not be considered as balanced in terms of power. Thus, several authors stressed a need for more research to increase insight into reasons for lower level of external integration at interdependent relationships (Grundlach and Cadotte, 1994; Gulati and Sych, 2007).

Defining high level of customer-supplier interdependence

High interdependence between SC actors (i.e. customer-supplier integration) has been studied from various perspectives in previous literature. Consequently, there is no single unifying definition of high interdependence. In Resource Dependency Theory (RDT) the concept of power is emphasized (Vijayasarathy, 2010; Pfeffer and Salancik, 1978). High interdependence refers to situation when neither customer nor supplier is more powerful than the other and both parties have the ability to influence each other (Ritter et al., 2004). The concept of power in relation to interdependence is also discussed in purchasing and buyer-supplier literature (e.g. Kähkönen, 2014; Hoejmoose et al., 2013; Sanderson, 2009; Caniëls and Gelderman, 2007). Interdependence has also been conceptualized as mutual power/dependency (e.g. Cox et al., 2004) and it is connected to aspects that can be grouped as organizational (e.g. size, status, technology), relational (e.g. information exchanged, trust, commitment), and environmental (e.g. supply and demand market size, alternatives on market, and availability) (Kähkönen, 2014).

Yet another important stream of literature (e.g. Pero and Lamberti, 2013; Bankvall et al., 2010; Danese, et al., 2004) rely on Thompson's (1967) definition of reciprocal interdependence from his taxonomy of interfaces. As vital determinants of the level of interdependence, several aspects are discussed such as complexity of interactions, information exchanged, the number of relationship links (Hammervoll, 2009; Danese et al., 2004), and uncertainty (Skipper et al., 2008). On the other hand, in marketing channels literature, interdependence is founded on Emerson's (1962) conceptualization of power-dependence (i.e. motivation to invest in a relationship, replaceability of a partner) closely related to that addressed in RDT. The high level of interdependence is determined by high environmental uncertainty (Frazier and Antia, 1995), essentiality and criticality of the exchange (Caniëls and Gelderman, 2007; Heide, 1994; Buchanan, 1992), and the reciprocity in power dependency of such relationship (Emerson, 1962; Kähkönen, 2014). In SCT theory (e.g. Hui et al., 2008; Donaldson, 2001), interdependence (based on Thompson's view) is seen as a mediator of fit between organizational context and level of integration activities. High level of interdependence denotes high level of required integration between actors.

To summarize, the above presented discussion indicates that the conceptualization of interdependence varies among the different theoretical perspectives. However, common aspects of the concept across the various streams of literature are *environmental* referring to the actors' supply and demand side situation of their supply chains (e.g. Buchanan, 1992), *exchange* relating to complexity of the exchange among partners,

financial and cost aspects (e.g. Ritter et al., 2004), and *relational* include power, trust and mutual reliance (e.g. Lusch and Brown, 1996). Table 6 summarizes the aspects and their determinants.

Table 6 Conceptualization of high interdependence in SCI literature

Interdependence related aspect	Example operationalization	References
Environmental	<ul style="list-style-type: none"> • Low availability of alternative suppliers/ buyers • High environmental uncertainty • Buyer and supplier has relatively high % share of total market for the other 	Buchanan 1992; Heide 1994; Frazier and Antia 1995; Skipper et al. 2008
Exchange	<ul style="list-style-type: none"> • High financial magnitude of the exchange resources • Each actor is expected to benefit more from a current exchange than from alternative exchanges • High switching costs • Complexity of the exchange 	Ritter, et al. 2004; Emerson 1962; Kähkönen 2014; Caniëls and Gelderman 2007; Geyskens et al. 1996
Relational	<ul style="list-style-type: none"> • Neither party has power advantages to alter the power balance • High level of mutual significance of both partners • Information exchanged • Trust and mutual reliance of both partners • Longer prior duration of the relationship • Motivational investments like mutual compromise, support, strategic planning, long-term relationship orientation 	Lusch and Brown 1996; Ritter et al. 2004; Caniëls and Gelderman 2007; Geyskens et al. 1996; Sanderson 2009; Kähkönen, 2014

Reasons for low external integration in high customer-supplier interdependencies

In existing rather fragmented literature, several previously documented reasons were identified which lead to a lower or limited level of external integration in interdependent customer-supplier relationships (see Table 7).

The table summarizes nine reasons including their effect on integration: (1) Misperception of the structural circumstances: buyer may misjudge the existing supply options (Caniëls and Roeleveld, 2009), (2) Customer's insufficient internal competence, for example, to implement an appropriate integration with suppliers (Cox et al., 2004), (3) Extensive closeness in the customer-supplier relationship leading to decreased commitment as partners might not to seek solutions on differences (Kumar et al., 1995), (4) High frequency of interaction might reduce the need for

Table 7 Reasons of low external integration in high interdependencies

Reason	Example characterization	Reference
Misperception of structural circumstances	<ul style="list-style-type: none"> Customer may misjudge the actual availability of supply options which can be misused by a supplier and lead to committing excessive resources in the relationship 	Caniëls and Roeleveld (2009)
Customer's insufficient internal competence	<ul style="list-style-type: none"> Customer's insufficient internal competence to implement an appropriate strategy with suppliers Customer outsourced its own competence and established long-term agreement with the outsourced partner. The interdependence shifted to supplier dominance 	Cox et al., (2004)
Extensive customer-supplier closeness	<ul style="list-style-type: none"> Too much closeness reduces commitment Partners do not seek to bridge differences Highly interdependent partners face larger uncertainty and worse exchange situation due to criticality of the exchange resources for both partners. Risk for long uncertain bargaining, higher related costs as a consequence of excessive demands of one actor. 	Kumar et al., (1995) Casciaro and Piskorski (2005)
High frequency of interactions	<ul style="list-style-type: none"> The need for frequent information exchange for control purposes decreases as frequency of interaction increases 	Caglio and Ditillo (2012)
Low absorptive capacity and low market orientation	<ul style="list-style-type: none"> Low ability of an organization to receive, integrate and use new knowledge coming from outside Low ability of an organization to acquire, spread and to respond to systems and their changes 	Pero and Lamberti (2013)
Customer's channel position too close to end-customer	<ul style="list-style-type: none"> Power of the customer increases and the willingness to collaborate with supplier decreases the closer the customer is to the end-customer 	Kähkönen (2014)
High financial stakes with long term impact on firm's strategy	<ul style="list-style-type: none"> High financial stakes can cause firms to deliberately use coercive (e.g. punishment, threats, demands) rather than non-coercive strategies (e.g. reward, promises, information persuasion) 	Gundlach and Cadotte (1994)
Failure to perform on agreed terms	<ul style="list-style-type: none"> Limited performance according to the agreed terms can negatively affect the viability and success of the interdependent relationship 	Narayandas and Rangan (2004)
Too long of a relationship length	<ul style="list-style-type: none"> The long length of the relationship might lead to: <ul style="list-style-type: none"> Firm's lost ability to be objective, Trade-partner is perceived to become 'too similar' in their thinking Increased performance expectations leading to dissatisfaction Misuse of trust and development of opportunistic behavior 	Greyson and Ambler (1999)

regular information sharing for control purposes (Caglio and Ditillo, 2012), (5) Low absorptive capacity and low market orientation to obtain, integrate, use and share new knowledge (Pero and Lamberti, 2013), (6) Customer's position in the supply chain is too close to the end customer, which might result in increased power and reduced willingness to collaborate (Kähkönen, 2014), (7) High financial stakes with long-term impact on firm's strategy might inspire the use of coercive strategies (e.g. punishment, threats, demands) with business partners (Gundlach and Cadotte, 1994), (8) Failure to perform on agreed terms can have negative impact on the viability and success of the interdependent relationship

(Narayandas and Rangan, 2004), and (9) Length of the interdependent relationship can decrease high level of integration as the relationship becomes long-term (Grayson and Ambler, 1999).

2.2.5 Existing frameworks for evaluation of external integration

The purchasing portfolio approach, developed by Kraljic (1983) suggests that the type of relationship established with a supplier differs depending on type of items purchased (i.e. bottleneck, strategic, leverage, and non-critical items). The type of relationship is defined by two dimensions: 1) supply market complexity (e.g. number of potential suppliers, barriers to entry), and 2) the financial impact of the purchasing activity. The author developed for each of the items a unique purchasing strategy and relationship. Furthermore, he offers recommendations on what information to share and what main tasks need to be performed between the SC actors.

Another well-known framework, proposed by Fisher (1997) is a matrix which differentiates between functional and innovative products. The functional products are linked with efficient supply chains, while the innovative ones with responsive supply chains to maximize performance. The attributes considered to distinguish between the functional and innovative products are factors such as demand pattern, product cycle, contribution margins, product variety, average forecast errors and stock outs, and finally lead times. The matrix has been extended by Lee (2000) who investigated demand and supply uncertainties of different type of products. Van Donk and van der Vaart (2005) concentrated on the factors of uncertainty as they are the main driver of integration with customers, according to the authors. Collaborative relationships are recommended for strategic products, while there is no need for close relationships for non-critical items unless a cost advantage can be obtained. Christopher et al., (2006) then added to the Fisher's framework replenishment lead-times and predictability/variability of demand as determinant for selecting appropriate supply chain strategies.

The existence of the essential but often overlapping framework contributes to the fragmentation of the SCI literature (Frankel et al., 2008). The frameworks lacks in discussing what contextual factors promote or inhibit external integration. Furthermore, the frameworks are restricted in discussing what specific integration activities to establish with business partners considering organizational context (cf. Zhao et al., 2013; Danese, 2011). Also, although previous studies has demonstrated a positive effect of both customers' and suppliers' integration on a firms' performance (e.g. Droge et al., 2004; Frohlich and Westbrook, 2001) they are mainly based

on studying integration of a company either with customers or suppliers rather than considering both actors simultaneously.

2.3 Evaluation of internal integration

According to several authors, internal cross-functional integration is difficult to implement in practice (Ralston et al., 2015; Fawcett et al., 2015; Cook et al., 2011). One of the dominant reasons is divisionalization of organizational structure leading to different ways of thinking and divergent values of the functional areas (Piercy and Ellinger, 2015; Stank et al., 2011).

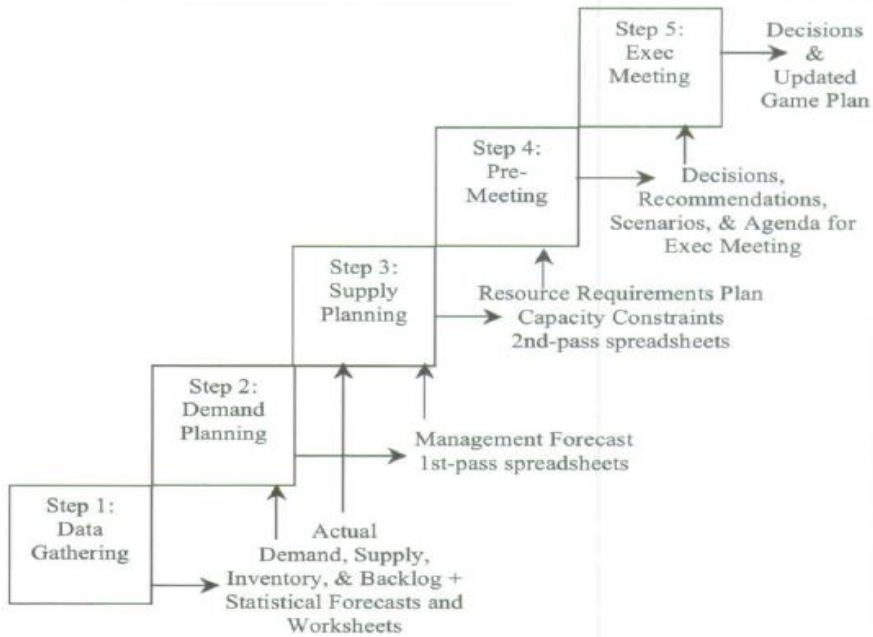
Previous research emphasized the criticality of aligning of two organizational areas – the demand side (e.g. marketing and sales) and supply side (e.g. operations and supply). The reason is that functional areas within the demand and supply side are involved jointly in creation of value for the customer (Piercy and Ellinger, 2015). Lack of integration between the demand and supply side results “...into the areas that plan for and manage demand being disconnected from those that must supply the resources and operational agility to meet the demand” (ibid: 50). Consequently, demand exceeding supply leads to shortages, unhappy customers and unrealized revenues. While supply exceeding demand means underutilized production assets, excess of inventory and increased costs (Esper et al., 2010).

Therefore, to enhance a firm performance and competitiveness, an integration of the supply and demand side is advocated by several authors (e.g. Piercy and Ellinger, 2015; Min and Mentzer, 2000; Stank et al., 2012). To attain a successful internal integration, alignment of functions such as sales, marketing and operations is advocated in order to serve the customer in a way that ensure product availability at a least cost and assets investments (Stank et al., 2011). The process that is directly involved in integrating the demand and supply side of an organization, and thus represents a tool in achieving internal integration is the Sales and Operations Planning (S&OP) process (Thomé et al., 2012a; Stank et al., 2011; Ling and Goddard, 1988).

2.3.1 Defining Sales and Operation Planning process

The S&OP process aims to unify different business plans (sales, marketing, and development, manufacturing, sourcing and financial) into one integrated set of plans at tactical level. The S&OP process has two major purposes: 1) balance demand and supply plans to align operational activities with strategic goals (Wagner et al., 2014; Thomé et al., 2012a; Grimson and Pyke, 2007; Lapide, 2004a; Olhager et al., 2001), and 2) to bridge the business or strategic plans and operational plans of an

organization. The process is typically conducted on a monthly basis as it is reviewed by management. The length of the planning horizon depends mainly on what horizon is sufficient to plan for resources and to support the annual business planning. The S&OP process which is well executed connects the strategic plans with its execution and reviews of performance measures to enable continuous improvements (Thomé et al., 2012a; Cox and Blackstone, 2002).



(Wallace and Stahl, 2008:20)

Figure 4 The five-step executive S&OP process

The S&OP process is characterized by five major steps (see Figure 4): 1) data gathering, 2) demand planning, 3) supply planning, 4) pre-meeting, and 5) executive meeting. In step 1 and 2, the personnel from sales develop a baseline unconstrained demand forecast which reflects what could be potentially sold to customers. The forecast considers expected responses to marketing plans, to new products introduction, and obsolete products. In step 3, the operations team collects all known information about inventory strategy, supply chain capacity and internal capacity. Then, the consensus demand forecast is utilized by the operations team to develop an initial supply plan which is also called rough-cut capacity plan. The supply plan is expected to meet the forecasted demand requirements. In step 4, the S&OP team creates the final S&OP plan for the next period. Financial

reconciliation of the plan with the business plan is conducted and agenda for the executive meeting is set. The team should be cross-functional including sales and marketing (i.e. demand management, forecasting), operations (i.e. purchasing, inventory management, supply chain operations, master production scheduling, etc.) and finance. Moreover, a participation of an S&OP champion (i.e. senior executive) is advocated, as well as key customers and suppliers to increase effectiveness of the pre-meeting. In step 5, an approval of the integrated S&OP plan from the pre-meeting is carried out. Additionally, decisions are made on issues outside the scope of the authority of the pre-meeting team, and finally the business performance is reviewed (Wagner et al., 2014; Grimson and Pyke, 2007).

While the previous S&OP literature offers a general descriptions of challenges related to design and implementation of the process (e.g. Wagner et al., 2014; Grimson and Pyke, 2007; Bower, 2005; Lapide, 2004a), the literature is rather scarce on systematically discussing challenges associated with evaluating the S&OP process performance (Thomé et al., 2012a).

2.3.2 Evaluation challenges of the S&OP process

The S&OP process is vital decision-making tool at both the tactical and strategic level. The tactical level includes decisions about enhancing or restraining demand when supply exceeds demand or when demand is greater than supply capacity. Examples of such decisions include increasing or decreasing advertising expenditures, pricing adjustments, and promotional activities. The strategic level of decisions relates to, for example, opening new markets, expanding distribution channels or supply capacity (Stank et al., 2011).

However, to evaluate the effectiveness and efficiency of the process, the current S&OP literature offers only limited guidelines. The literature is scarce on understanding the challenges related to measuring the process performance (e.g. Grimson and Pyke, 2007). The existing literature is fragmented and limited to a broad statements related to design, implementation and challenges to measure the process performance. To illustrate, although the previous research pointed out a need to undertake a process approach when evaluating the S&OP process, the systematic identification and structuring the measures is still missing (Thomé et al., 2012a).

The identified examples of challenges include mainly the lack of process oriented frameworks for evaluating the S&OP performance (Thomé et al., 2012a), the focus on functional performance rather than on performance of the process, too many measures, and their limited integration with

business strategy and reward systems (Tuomikangas and Kaipia, 2014; Thomé et al., 2012a; Grimson and Pyke, 2007).

As organizations typically achieve different maturity levels of the S&OP process implementation, the measurement challenges might differ at the various levels.

Measurement challenges at various S&OP process maturity levels

In S&OP literature, typically five levels in terms of measurement challenges are discussed (see Table 8): (1) no measures, (2) reactive, (3) standard, (4) advanced, and (5) proactive (e.g. Wagner et al., 2014; Grimson and Pyke, 2007). On the other hand, practitioners' literature distinguishes levels as follows: laggards, industry average, and best in class (Aberdeen Group, 2009).

Table 8 Measurement challenges related to maturity levels of the S&OP process

Measurement challenges related to maturity levels of the S&OP process					
Wagner et al., (2014)					
Level 0 Undeveloped	Level 1 Rudimentary	Level 2 Reactive	Level 3 Consistent	Level 4 Integrated	Level 5 Proactive
No tracking of planning performance	KPI's sporadically managed; not aligned cross-functionally, with strategy, reward	KPI's partly aligned cross-functionally, with strategy and incentives	Internal alignment of measures not performed	Irregularly performed internal alignment of measures	-
Grimson and Pyke (2007)					
Stage 1 No S&OP	Stage 2 Reactive	Stage 3 Standard	Stage 4 Advanced	Stage 5 Proactive	
Lacking info for decision making	Measurements of meeting the sales plans dominate	Meeting efficiency not monitored	Participation in process not evaluated; suppliers and customers not asked to evaluate the process	Measuring profit optimization is challenging	
Aberdeen Group (2009)					
Laggards		Industry Average			Best in Class
Low performance on:		Medium performance on:			-
Ability to express the S&OP plan in terms of revenue and margins; high-level reporting designed for executive management; proactively monitor daily performance against S&OP measures to be proactively alerted about deviations					-

(Hulthén et al., forthcoming)

According to Wagner et al., (2014) and Grimson and Pyke, (2007), level 1 is characterized by challenges related to lack of S&OP measures and ability to evaluate the process performance. For level 2 and level 3, gaps in alignment of measures across various organizational levels and evaluation of meeting efficiency were pointed out as problematic, while for level 4 and

level 5 the major issues represent designing of a measure to follow up a profit optimization rather than just focus on revenues and least costs (Aberdeen Group, 2009). Organizations that achieved level 5 are very rare (Grimson and Pyke, 2007).

2.3.3 Existing frameworks of S&OP process performance

To address the above presented challenges there is a need for development of a process oriented framework for evaluation of the S&OP performance (e.g. Tuomikangas and Kaipia, 2014; Thomé et al., 2012a; Milliken, 2008).

To develop such a framework, previous performance measurement literature identified set of criteria (Caplice and Sheffi, 1995) such as: comprehensiveness (i.e. including multilevel measures of financial results, customer satisfaction, and internal process efficiency), causal orientation (i.e. tracking root cause of performance), vertical and horizontal integration (i.e. capture the goal congruence between corporate and functional goals), internal comparability (i.e. define trade-offs measures including financial and non-financial measures), and usefulness (i.e. clarity of measures to support decision making).

However, the current measures in S&OP literature seem not to comply with many of the criteria above. The potential approach to solve this issue could be to apply the well-established balanced scorecard (BSC) or the SCOR-model. These were used in the S&OP measurement research by, for example, Milliken (2008) who proposed the S&OP scorecard and by Thomé et al., (2012a) who used SCOR-model for classification of existing S&OP measures (see Table 9). Yet after reviewing these approaches it was concluded that both are primarily design on a more aggregated level and do not consider specific activities involved in the S&OP process as a cross-functional (horizontal) planning process.

Other authors (Tohamy et al., 2013; Cecere et al., 2009; Grimson and Pyke, 2007) used maturity levels of the S&OP process, as presented in Table 10, to structure the measures. Level 1 lacks S&OP related measures and is characterized by standard financial accounting systems. Level 2 includes predominantly functional measures, and the demand/sales measures dominate over the operations measures (Grimson and Pyke, 2007). In level 3, integrated measures are introduced (Tohamy et al., 2013) while level 4 includes also measures of new product introduction and trade-offs to align contradicting functional goals. Furthermore, process efficiency measures emerge to offer a feedback to S&OP team members on their performance and participation in the process (Tohamy et al., 2013; Grimson and Pyke, 2007).

Table 9 Frameworks of S&OP Performance Measures

Frameworks of S&OP Performance Measures		Reference
Classification of measures		Thomé et al., (2012a)
Plan	Inventory turnover/level; track variations in inventory levels; rate of obsolete inventory; cash to cash cycle time; planning cycle time; forecast volatility; track variations in customer demand; order fill rate; product development cycle time; level of customer perceived value of product; total production	
Source	Lead time; materials quality; supplier fill rate; track variations of deliveries with suppliers	
Make	Capacity utilization; production lead time; production quality, track variations in production; flexibility (product, volume, mix); production costs; human resource productivity index; production capacity shortages	
Deliver	On-time delivery of goods; lead time; delivery reliability performance; track variations in delivery capability; delivery speed; delivery flexibility; distribution costs; customer satisfaction/ retention	
S&OP dashboard	Accuracy of forecast techniques; adherence to sales, marketing and operations plan; forecast vs order; total sales as proportion of demand; variance regarding baseline forecasts and budgets; measurement of major strategic initiatives; actual vs planned demand; actual vs planned production; actual vs planned inventory; actual quantities shipped vs quantities ordered	
End-results	Gross profit return on space; return on net assets; gross profit return on inventory; company/ product profitability; contribution margins	
S&OP Scorecard		
Demand	Total demand; demand vs S&OP; forecast accuracy	
Production	Total production; production vs S&OP; S&OP capacity utilization	
Inventory	Total finished goods inventory; inventory vs S&OP; raw materials inventory; non-saleable inventory	
Logistics	On-time shipping; actual shipped quantity vs order quantity; total fixed distribution cost	

(Hulthén et al., 2016)

Finally, level 5 is associated with profitability measures. Managers are kept responsible for meeting plans, and joint achievement of cost effective outcomes in order to maximize profitability.

Similarly, to the previous two approaches, this one does not consider specifically the individual activities within the S&OP process as a cross-functional (horizontal) planning process. Moreover, the match between corporate and financial goals is restricted to profit, and additional measures of how the process affects organization’s profit are scarce (Cecere et al., 2009; Grimson and Pyke, 2007). Horizontal integration and internal comparability of measures via trade-offs is insufficient.

Table 10 Maturity level of S&OP performance measures

Maturity level	Reference/ S&OP measures		
	Grimson and Pyke (2007)	Tohamy <i>et al.</i> (2013)	Cecere <i>et al.</i> (2009)
Level 1	- No measures	- Order fill rates - Inventory costs	
Level 2	- Operations meet the sales plan	- Functional costs - Forecasted error - On time shipment	- Assets utilization - Inventory levels - Order fill rate
Level 3	- <i>Level 2 plus:</i> - Sales on forecast accuracy	- On time delivery - Supplier lead time - Order cycle time - Integrated measures	- Order fill rate - Inventory turns - Functional costs - Forecast error
Level 4	- <i>Level 3 plus:</i> - New product introduction - S&OP efficiency	- Trade-offs - Forecast variability - Total costs - Perfect order - Lead times	- Working capital - Total costs - Customer service - Demand error
Level 5	- <i>Level 4 plus:</i> - Profitability	- Supply chain trade-offs	- Demand risk - Customer service - Cash flow - Market shares - Profit

(Hulthén *et al.*, 2016)

2.3.4 Initial process oriented framework for S&OP process performance

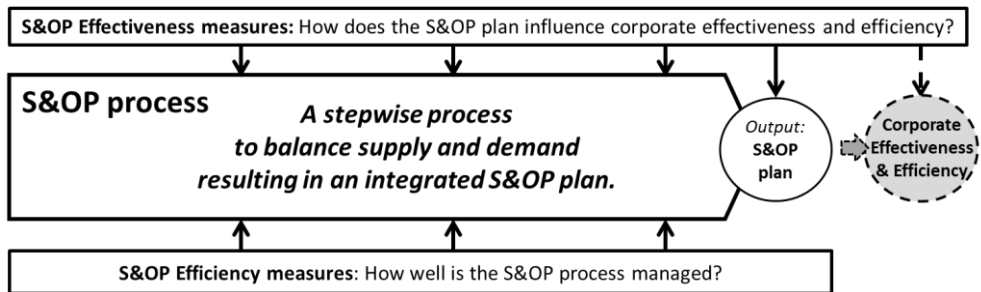
To address the lack of process oriented frameworks for evaluating the S&OP performance (Thomé *et al.*, 2012a) the performance measurement research was reviewed. In existing literature, two key areas are often considered when evaluating performance of a business process such as effectiveness and efficiency (Fugate *et al.*, 2010; Gunasekaran and Kobu, 2007; Neely *et al.*, 1995; Mentzer and Konrad, 1991). Effectiveness refers to “...the extent to which customer requirements are met” while efficiency to “...how economically the organization’s resources are utilized when providing a given level of customer satisfaction” (Neely, 1998:5).

These two key areas were previously applied by van Weele (2014) for evaluation of purchasing process performance. The author views purchasing as a cross-functional process with the objective to satisfy internal customers (i.e. the right products at the right time to the right cost). It can be argued that there are several similarities between the S&OP process and the purchasing process. Both can be considered as cross-functional support processes, with the corporation’s management as internal customer. Purchasing effectiveness is in van Weele (2014) defined as related to the goals (and internal customers) for that process. On the other hand, purchasing efficiency relates to measures of purchasing organization (i.e. procedures, guidelines, systems and staff). The measures

capture the relationship between planned and actual costs for resources used in the purchasing process.

Due to the similarities, the van Weele’s (2014) framework supplemented by the two key areas of effectiveness and efficiency (Neely, 1998) could be applied to the context of the S&OP process. Thus, the *S&OP process performance* can be defined as the degree to which the S&OP process is able to realize the predefined goals with a minimum of corporate resources. To propose a framework for measuring S&OP process performance, two major areas of process performance suggested by Neely (1998) has been used such as process effectiveness and efficiency.

As presented in the initial framework in Figure 5, an effective S&OP process is expected to arrive at an S&OP plan that balances demand and supply in order to meet customer requirements. It also influences both the overall corporate effectiveness and corporate efficiency. So, *the S&OP process effectiveness* means how effective an organization is in meeting external customers’ requirements as well as how efficient it is in allocating corporate resources. While the *S&OP process efficiency* relates to how well the process itself is managed. It also indicates how well is the process internally integrated.



(Hulthén et al. 2016)

Figure 5 Initial framework for measuring S&OP process performance

Measures of S&OP process performance

The S&OP literature was reviewed to identify existing S&OP related measures (see Table 11). It can be concluded that majority of the identified measures relates to S&OP process effectiveness, while there were rather few measures related to S&OP process efficiency. Closer examination of the effectiveness measures revealed that they do not follow the process structure with connected activities and outputs. Thus, in order to further categorize the measures three categories of demand, supply or other

measures were selected to capture the demand and supply side of the process.

Examples of *S&OP process effectiveness* and *demand* are customer perceived value of products (Burrows, 2007), forecast accuracy, new products related measures (Grimson and Pyke, 2007), and adherence to sales/marketing plans (Lapide, 2004a, b). Several authors stressed quality of input data demand planning (Bower, 2005).

S&OP process effectiveness measures associated with *supply* are, for example, delivery reliability (Godsell et al., 2010), inventory levels (Chae, 2009), capacity utilization (Grimson and Pyke, 2007), production and distribution costs (Milliken, 2008), and adherence to operations plans (Lapide, 2004a, b). To allocate the minimum amount of necessary resources, it is crucial to align across functions the often conflicting functional goals with business goals to support the process view. To achieve this, several authors advocate cross-functional trade-offs between measures, for example, between customer service and inventory levels, between flexibility and supply chain costs (Tuomikangas and Kaipia, 2014), and customer service versus inventory (Thomé et al., 2012b). However, the existing S&OP and performance literature is scarce regarding which trade-offs would be optimal for measuring the output of the process but also the performance of the individual process steps.

Wagner et al., (2014) and Godsell et al., (2010) emphasize integration of cross-functional measures with business strategy and reward system to support the vision of alignment. Moreover, financial measures, such as return on assets (Keal and Hebert, 2010), company/product profitability (Grimson and Pyke, 2007), and contribution margins (Milliken, 2008) are often included. Related to financial reconciliation of S&OP plans, Oliva and Watson (2011) stressed comparison between converted plans from units to the organization's financial targets.

S&OP process efficiency relates to how well the S&OP process itself is managed. Examples of aspects are cross-functional integration, procedures, organization and resource utilization. While several authors mention these and other aspects, they provide few measures for monitoring these aspects. Bower (2005), for example, discusses monitoring of follow up activities; Grimson and Pyke (2007) stress communication of plans, while other authors add meeting efficiency, monitoring the attendance of all S&OP team members, pre-meeting work done on time, and the re-planning frequency (Cecere et al., 2009; Lapide, 2004a). Both Bower (2005) and Lapide (2005) also emphasize how top management support is pivotal. Yet, existing literature is scarce on how to measure these aspects of S&OP process efficiency.

Table 11 An overview of measures related to S&OP process performance

Areas of S&OP performance measures	Demand related measures	Supply related measures	Other measures
<p>S&OP Process Effectiveness How does the S&OP plan influence corporate effectiveness and efficiency</p>	<ul style="list-style-type: none"> - Forecast accuracy/variability - New product development cycle time and new launches (Grimson and Pyke, 2007) - Customer perceived value of products (Burrows, 2007) - Expected responses to promotions (Wagner <i>et al.</i>, 2014) - Adherence to sales and marketing plans (Lapide, 2004a,b) - Quality of data for demand planning (Bower, 2005) 	<ul style="list-style-type: none"> - Delivery reliability, lead time, speed, flexibility, variation in delivery - Distribution costs (Godsell <i>et al.</i>, 2010) - Inventory levels, turnover, obsolete inventory - Labor productivity index - Materials quality (Chae, 2009) - Production, distribution costs (Milliken, 2008) - Order fill rate (Boyer, 2009) - Customer order backlogs - Deviations in actual and planned inventory levels vs capacity utilization (Wagner <i>et al.</i>, 2014) - Production, lead time, quality variation, costs (Milliken, 2008; Chae, 2009) - Capacity utilization, shortage (Grimson and Pyke, 2009) - Flexibility (mix, volumes) (Gianesi, 1998) - Supplier lead time, fill rate, variation in deliveries (Chae, 2009; Singh, 2010) - Adherence to operations plans (Lapide, 2004a,b) 	<ul style="list-style-type: none"> - Total sales vs demand - Contribution margins (Milliken, 2008) - Customer service vs inventory; meeting demand with reduced inventory (Thomé <i>et al.</i>, 2012b) - Flexibility vs SC costs (Tuomikangas and Kaipia, 2014) - Baseline forecast vs budget (Lapide, 2004a; b) - Cash to cash cycle time (Chae, 2009) - Return on assets (Keal and Hebert, 2010) - Gross profit return on inventory (Harwell, 2006) - Company/ product profitability (Grimson and Pyke, 2007) - Expected revenue of plans vs financial targets (Oliva and Watson, 2011) - Integration of measures cross- functionally, with business strategy and reward system (Godsell <i>et al.</i>, 2010)
<p>S&OP Process Efficiency How well is the S&OP process managed</p>	<p>NA</p>	<p>NA</p>	<ul style="list-style-type: none"> - Cross-functional integration of plans; supply and demand planning in balance; planning linked to execution; monitoring of actual performance against S&OP metrics - Meeting efficiency; information preparation and sharing, holistic view of supply and demand to (Bower, 2005) - Measure and communicate plans; revision of measures (Grimson and Pyke, 2007) - Accountability for measures (Grimson and Pyke, 2007; Bower, 2005)

(Hulthén *et al.*, 2016)

3. Research design and methodology

In this chapter, the author's ontological and epistemological position is presented. Then, the overall structure and research design in this dissertation is outlined, followed by a description of the methodological approaches of the three studies that represent the main source of primary data in the dissertation. Finally, research trustworthiness is discussed and reflections on the methodological approaches are presented.

3.1 Scientific reasoning

The question of research methods should be preceded by questions of the researcher's paradigm which represents the fundamental worldview that determines the selection of a certain method. The paradigm is also vital in defining the researcher's epistemological and ontological position (Guba and Lincoln, 1994; Åsberg, 2000).

3.1.1 Research paradigm

The paradigm that reflects the authors view and which is adopted throughout the research is a functionalist paradigm. The main assumption of this paradigm is the problem-oriented nature of the applied approach which aims to offer a solution to practical issues. Furthermore, within this paradigm organizations are considered to be rational entities facing rational problems which can be addressed by offering rational solutions (Saunders et al., 2009). This paradigm entails two conceptual dimensions such as objectivism and a regulatory perspective representing the ontological position of the author.

3.1.2 Ontological position

Ontology is related to questions of the assumptions that we make about the way the world works. Objectivism refers to the ontological position declaring that organizations exist in a reality which is external and independent of the actors involved in their existence. In this paradigm it is believed that the management is influenced by the objective aspects of the management function (i.e. formal structure, reporting structure, job descriptions) (Saunders et al., 2009). Similarly, Bryman and Bell (2007) concluded that the objectivism implies that organizations as social entities are outside our reach and influence; they are external to us who are concerned with their existence. An organization is seen as tangible objects shaped by rules, regulations, and standardized procedures. This position is a rather common way of conceptualizing organizations in the field of logistics and SCM. Organizations are seen as having a pre-defined set of

formal properties that may represent in some situations a restriction to individuals' actions.

The objectivism is then combined with a regulatory perspective which is concerned with providing rational explanations to problems experienced by organizations. It also aims at development of recommendation on how to enhance the current situation (Saunders et al., 2009).

In this research, the studied phenomena such as the challenges and evaluation of external integration and the S&OP process are perceived to be influenced by the objective aspects given by an organizational structure (i.e. internal and external contextual factors, level of external integration and maturity level of the S&OP process implementation). Additionally, the regulatory perspective is reflected by objectives of this dissertation to develop framework for evaluation of external integration and for evaluation of the S&OP process performance. The aim is to add to existing SCI literature but also provide guidelines for practitioners in order to enhance the current practice within this area.

3.1.3 Epistemological position

Epistemology considers questions related to nature of knowledge and what constitutes adequate knowledge in the studied field (Saunders et al., 2009, Guba and Lincoln, 1994). The epistemological position that corresponds to the author's objectivistic ontological position is a critical realism.

Critical realism – the author's position

The essence of the critical realism position is explained by Guba and Lincoln (1994:110) as follows: "reality is assumed to exist but to be only imperfectly apprehendable because of basically flawed human intellectual mechanisms and the fundamentally intractable nature of phenomena." Critical realists argue that the social world differs from the natural one in that it is dependent on human actions. In other words, it is socially constructed (Sayer, 2000; Archer, 1995; Bhaskar, 1986). Another important distinction is the differentiation between the "real", the "actual", and the "empirical". The "real" denotes structure with related causal powers, the "actual" refers to events and processes, while the "empirical" represents the portion of the two that is perceived by the social actors. The knowledge is then generated through abstraction from the observable events with goal to understand the pre-structured nature of social practices. Then, the real events, actions and processes are analyzed and matched with this knowledge (Fairclough, 2005).

The author's motives for this position are consistent with the argument made by Bhaskar (1989) that what we observed represents only a fraction

of the whole picture. Additional motive is that the critical realists emphasize the necessity of conducting multi-level studies as each level contributes to researcher's understanding of the studied phenomenon. This position, further, reflects the idea that the social world is in constant change. The focus is on context and that the researcher is aware of biases such as the world view that impact on his/her research. Consequently, the purpose of research is to understand the reason for phenomena in order to be able to recommend a change (Saunders et al., 2009). The *context* is considered as essential in understanding the reasons as social activities are dependent on the conditions in which they take place. The investigated phenomenon has to be viewed jointly with its context as they are interconnected (Patomäki and Wight, 2000).

3.2 The overall structure and design of research

The choice of an appropriate research design should be grounded in particular research objectives, the extent of the existing knowledge, the researcher's own philosophical position and also on time and other resources available (Saunders et al., 2009). To address the purpose and the research objectives in this dissertation three interrelated studies have been conducted.

3.2.1 Study 1

Study 1 is based on an extensive literature review carried out in three steps. This study increased the author's understanding of the various aspects and challenges of the SCI concept. Study 1 shows that there is a lack of empirically based studies extended beyond dyadic relationships to support the theoretical prediction of improved performance through SCI. Yet another important issue in the previous integration literature was pointed out, namely the lack of comprehensive frameworks for evaluation of SCI.

3.2.2 Study 2

Informed by the main results of Study 1, to address the challenges, the purpose of Study 2 was to investigate the effect of contextual factors on external integration.

Given the rather underdeveloped status of the existing integration literature in this matter, the Grounded Theory (GT) approach was considered as the most appropriate method (Corbin and Strauss, 2008). The major reason is that rather than to limit the development of theory through the traditional hypothetical deductive methods, this approach allows for development of theory grounded in the empirical data themselves (Charmaz, 2006). Yet another reason was the goal to identify a

wide range of contextual factors and integration activities rather than to define the unit of analysis to narrowly (Mello and Flint, 2009).

To be able to study the effect of the contextual factors on external integration beyond dyads, two supply chains from various industries (i.e. innovative – medical technology industry and functional - fast moving consumer goods industry) were selected. To meet the criticism which has been raised in Study 1, the studied sample comprised of three companies (first-tier suppliers; focal companies; first-tier customers) in each of the two supply chains.

3.2.3 Study 3

The findings of Studies 1 and 2 pointed out challenges but also the criticality of internal integration for, among others aspects, satisfactory external integration with SC partners. Against this background the focus of Study 3 shifted towards the internal integration, specifically the S&OP process.

As a result of reviewing the existing S&OP literature it has been detected that there is a lack of a standardized approach for systematic evaluation of the S&OP process performance. Thus, to address this issue a multiple-case study method was used based on six cases from various industries. The motivation for applying case study methodology is that the aim was to investigate the use of commonly established concepts from performance literature (i.e. effectiveness and efficiency) in the S&OP process settings. Also, in line with the purpose, the unit of analysis was narrowed down to performance measurement practices of the S&OP process. The argument for using multiple cases was that the cases should represent different maturity levels of the S&OP process implementation which was believed to have an impact on how the process performance was evaluated as well as the related evaluation challenges.

3.2.4 Summary

The three studies were reported in five research papers. Studies 1 and 2 were previously reported in a licentiate thesis (Hulthén, 2013). Additionally, Study 1 resulted in research Paper 1 (P1), while Study 2 led to development of P2 and then was further extended in P3. Study 3 resulted in P4 and P5. The link between the three studies and the related publications is presented in Figure 6. While the process of designing these studies and collecting the empirical data was mainly linear, the process of analyzing and reporting can be considered as an iterative one. The papers are result of involvement of multiple actors both scholars and the informants with different backgrounds who reviewed and provided feedbacks in various stages of the research and reporting process. The

papers have been, or are, subject of multiple peer reviews which resulted in improvement by considering different theoretical perspectives. This led to several rounds of additional analysis of the collected empirical data.

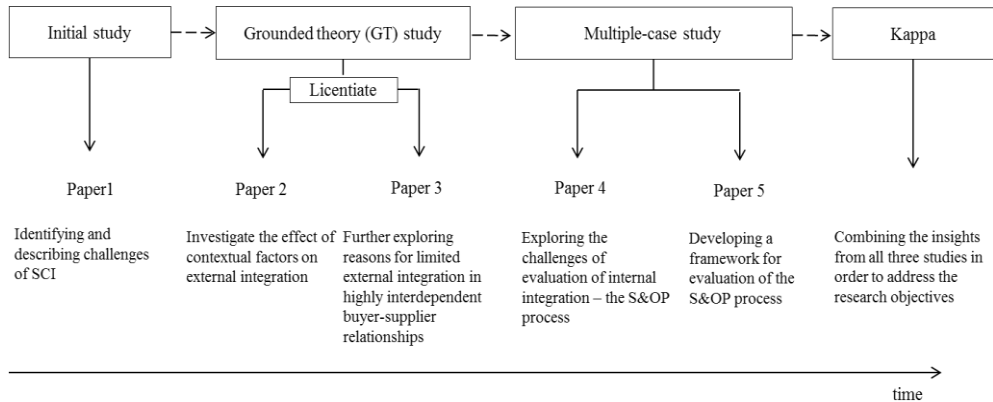


Figure 6 Development of the three studies and Kappa through time

As presented in Table 12, Study 1 is of a descriptive nature as it attempts to offer an accurate representation of a situation (Robson, 2002). In the particular study, the situation represents the existing aspects of SCI and related challenges. Also, the descriptive study allowed for obtaining an insight in what is the current status of SCI literature and practice. Study 1 is the forerunner to the following Study 2 which is an exploratory one with aim to seek new insights into how context influences external integration. Similarly, Study 3 is of an exploratory nature as it seeks for an understanding of the challenges related to evaluation of the S&OP process performance in order to suggest a possible solution – the framework for performance evaluation of the process.

The research design for each of the three studies will be described in the next sections in terms of sampling and data collection, data analysis, and research trustworthiness.

Table 12 Linking research objectives with studies and publications

RO	Description	Study 1	Study 2		Study 3	
		P1	P2	P3	P4	P5
1.	To identify challenges of Supply Chain Integration.	Described	Explored	Explored	Explored	
2.	To propose a context-based framework for evaluation of external integration.		Explored			
3.	To propose a framework for performance evaluation of the Sales and Operations Planning (S&OP) process.					Explored

3.3 Study 1 – Paper 1

The initial study has been conducted to examine various aspects and challenges of SCI. To obtain an insight into the existing SCI literature, the applied methodology includes literature review. The unit of analysis was aspects of SCI. The study resulted in Paper 1 (see Table 12).

3.3.1 Sampling, data collection and analysis

An extensive literature review was carried out in two rounds of literature reviews (I, II) including three major steps. The main goal was to gain a general understanding of the SCI concept in terms of the key aspects and to develop an insight into previous relevant research and the potential gaps (Saunders et al., 2009; Meredith, 1998). Each of the steps represented an increased level of depth of the analysis (see Table 13).

The first step of the literature review was focused on a broad identification of what are the key aspects of SCI related to scope of SCI, areas of SCI and levels of relationship. To do so, research databases such as Scopus, Ebsco and Google Scholar were used as these are expected to cover the major articles on the topic. In total about 600 articles were identified and reviewed (with focus on abstracts and conclusions) to develop the key aspects.

Table 13 Study 1 – literature review process

Step	Goal	Data collection	Final sample
Literature review I			
1	<ul style="list-style-type: none"> Initial identification of key aspect of SCI General understanding of the SCI topic 	Research databases <ul style="list-style-type: none"> Ebsco, Scopus, Google scholar Key words <ul style="list-style-type: none"> Scope, areas and levels of SCI 	600
Literature review II			
1	<ul style="list-style-type: none"> Identify how the SCI has been empirically studied 	Logistics/ SCM journals <ul style="list-style-type: none"> Journal of Business Logistics, Journal of Supply Chain Management International Journal of Logistics Management International Journal of Physical Distribution and Logistics Management Supply Chain Management: An International Journal Final sample selection based on: <ul style="list-style-type: none"> Empirical papers SCI related topics 	117
2	<ul style="list-style-type: none"> Identify what, how, why to integrate Identify proposed benefits of SCI 	In-depth analysis of 49 articles identified in step 1 Analysis based on: <ul style="list-style-type: none"> What, how, why to integrate, benefits of SCI 	49

In step two, literature review number II was performed with aim to map how the topic of SCI has been empirically studied. For that purpose, five logistics/SCM journals were selected based on Gibson’s et al. (2004) ranking based on a periodical usefulness assessed by scholars in terms of quality of articles, impact on discipline, and value for your research. The selected highest scoring journals are: *Journal of Business Logistics*, *Journal of Supply Chain Management*, *International Journal of Logistics Management*, *International Journal of Physical Distribution and Logistics Management*, and *Supply Chain Management: An International Journal*.

In total 117 papers were identified as relevant as they investigated SCI-related topics and were empirically based. Next, the articles were further scrutinized and only 49 articles addressing any of the three key areas of SCI were selected for additional analysis. In the third step, the 49 articles were further in-depth analyzed to identify what, how and why to integrate, including the proved benefits of integration.

3.4 Study 2 – Paper 2

Study 2 was designed with the aim to address the challenge of a still missing comprehensive framework for external integration and the predominantly dyadic scope of existing empirical integration research. A review of external integration literature revealed fragmented knowledge on how the business context impacts integration activities with SC partners (Danese, 2011; Mortensen and Lemoine, 2008; Lummus et al., 2008). Thus, the Grounded Theory (GT) approach is argued to be an appropriate method, as the existing knowledge contains discrepancies, contradictions and ambiguities and further development of the theory is desirable (Corbin and Strauss, 2008). The study resulted in Paper 2.

3.4.1 Case selection

The GT approach allows for a theoretical sampling. The idea is to collect data from places that ensure maximum opportunity to obtain rich data for concepts development in terms of their attributes, and to reveal variations and relationships between those concepts (Corbin and Strauss, 2008). Therefore, two criteria for sampling were applied. First, the aim was to select samples that offer a maximum variation in terms of the context (Dubois and Araujo, 2007) in order to study the effect of the context on the integration activities among SC actors. Second, to meet the criticism of limited research beyond dyadic relationship, two supply chains (i.e. three SC actors) were selected; Supply chain A (SC-A) from the medical technology (MedTech) industry and Supply chain B (SC-B) from the fast moving consumer goods (FMCGs) industry with variation in their contextual characteristics.

Regarding the first criterion, *the scope of the sample*, the following companies in both SC-A (MedTech) and SC-B (FMCGs) were selected: a key first-tier supplier, a focal company, and a key first-tier customer (see Table 14). The selection of the key customers and suppliers was a result of a preliminary analysis of the initial interviews with the focal companies (Corbin and Strauss, 2008). These interviews pointed out what actors should be approached for the subsequent interviews.

In the SC-A, the focal company (FC-A) focuses on production of surgical and medical components and it is a subcontractor with wide technological expertise within product development and manufacturing. The key first-tier customer is an OEM, a global medical technology company. Production of components that are not available on the market are outsourced to FC-A. The first-tier customer belongs to the 10% of customers which account for 90% of FC-A sales. The key first-tier supplier is regional representative of a large global raw material producer and it is among the 25% most critical

suppliers of FC-A. However, for the first-tier supplier the volumes purchased by the FC-A are small. Furthermore, volumes produced by FC-A are small in comparison to volumes of the first-tier customer and first-tier supplier.

In the SC-B, the focal company (FC-B) is a regional consumer packaging producer who is a part of a leading global organization. The key first-tier customer is within the FMCGs sector and belongs to the top customers accounting for 70% of FC-B sales. The key first-tier supplier is a large global raw material supplier which accounts for up to 80% of one of the main raw materials used by the FC-B. Volumes of FC-B are similar to those produced by the first-tier customer as well as the supplier. All companies in both supply chains are located in Europe.

Related to the second criterion, various *organizational context characteristics*, SC-A is characterized by innovative products with high complexity. The strategic goal is high product quality and traceability which is essential in the MedTech industry. The studied companies are exposed to rather high technological change which requires on-going materials and products development. Environmental change is demonstrated by low complexity of FC-A's supply side with few and stable actors. There is high resource availability with alternative sources. The demand side is described by many and changing actors and thus high complexity. The alternatives are limited mainly due to the needed specific technological expertise, assets and the certification due to stringent quality requirements. Demand predictability is low for new products, while for established products the predictability is relatively high. In terms of power between actors the first-tier supplier is the dominant actor as it is much larger in terms of size compared to FC-A and since volumes purchased by FC-A only represent a small portion of the total sales of the supplier. Between the FC-A and the first-tier customer there is interdependence mainly due to the reasons related to resource availability as discussed above.

Table 14 Summary of the main characteristics of SC-A and SC-B

Supply chain scope					
SC-A			SC-B		
First-tier supplier	Focal company A	First-tier customer	First-tier supplier	Focal company B	First-tier customer
<ul style="list-style-type: none"> - Regional representative of global raw mat. producer - Among the most critical suppliers of FC-A - Large volumes 	<ul style="list-style-type: none"> - Development and production of surgical/ medical components - Subcontractor of the first-tier customer - Small volumes 	<ul style="list-style-type: none"> - OEM, a global medical technology company - Accounts for 90% of sales of FC-A - Large volumes 	<ul style="list-style-type: none"> - Global raw material producer - Accounts for 80% of supplies of the main raw materials for FC-B - Large volumes 	<ul style="list-style-type: none"> - Regional consumer packaging producer - Large volumes 	<ul style="list-style-type: none"> - Producer of end products in FMCGs sector - Accounts for 70% of FC-Bs total sales - Large volumes
Organizational contexts characteristics					
SC-A			SC-B		
First-tier supplier	Focal company A	First-tier customer	First-tier supplier	Focal company B	First-tier customer
Strategy					
Focus on high product quality			Focus on low cost, sustainability		
Type of products					
Innovative products			Functional products		
Technological change					
<i>High</i> <ul style="list-style-type: none"> - Development of new raw materials 	<i>High</i> <ul style="list-style-type: none"> - Development of new products 	<i>High</i> <ul style="list-style-type: none"> - Development of new products 	<i>Low</i> <ul style="list-style-type: none"> - Rate of innovations 	<i>Low</i> <ul style="list-style-type: none"> - Rate of innovations 	<i>Low</i> <ul style="list-style-type: none"> - Rate of innovations
Environmental change					
<i>Low</i> <ul style="list-style-type: none"> - Low complexity of FC-A's supply side with few and stable actors 	<i>High</i> <ul style="list-style-type: none"> - High complexity of demand side of FC-A with many and changing actors 	<i>Low</i> <ul style="list-style-type: none"> - Low complexity of FC-B's supply side with few and stable actors 	<i>Low</i> <ul style="list-style-type: none"> - Low complexity of FC-B's demand side with few and stable actors 		
Resource availability					
<i>High</i> <ul style="list-style-type: none"> - Alternative sources 	<i>Low</i> <ul style="list-style-type: none"> - Limited alternatives 	<i>Low</i> <ul style="list-style-type: none"> - Limited alternatives 	<i>Low</i> <ul style="list-style-type: none"> - Limited alternatives 	<i>Low</i> <ul style="list-style-type: none"> - Limited alternatives 	
Demand predictability					
<i>Low</i> <ul style="list-style-type: none"> - New raw materials 	<i>Low</i> <ul style="list-style-type: none"> - New components 	<i>Low</i> <ul style="list-style-type: none"> - New end products 	<i>High</i> <ul style="list-style-type: none"> - Predictable seasonal variation 	<i>High</i> <ul style="list-style-type: none"> - Predictable seasonal variation 	<i>High</i> <ul style="list-style-type: none"> - Predictable seasonal variation
<i>High</i> <ul style="list-style-type: none"> - Established raw materials 	<i>High</i> <ul style="list-style-type: none"> - Established components 	<i>High</i> <ul style="list-style-type: none"> - Established end products 			
Power between SC actors					
Supplier dominance over FC-A	Interdependence between FC-A and first-tier customer		Supplier dominance over FC-B	Interdependence between FC-B and first-tier customer	

SC-B is described by functional standard products with low complexity. The strategy is to attain low cost and sustainability. The environmental change that the all actors are exposed to is low. Both the demand and supply side is characterized by few and stable actors. The resource availability is seen as low due to limited alternatives on market as results of high entry barriers caused by large initial investments, large volumes of raw materials and components needed as well as low profit margins on the products. The demand predictability is high despite seasonal variation. The first tier supplier is the dominant actor due to its control over limited raw material resources which are of strategic importance for FC-B. There is interdependence between FC-B and the first-tier customer as results of limited alternatives on the market.

3.4.2 Data collection

The primary data were collected via 14 interviews lasting between one and one and half hour. Four of the interviews were pilot interviews with informants from manufacturing companies and consulting companies, as presented in Table 15. The aim of the pilot interviews was to confirm the potential relevance of the research topic, to gain initial insights into the subject, and eventually to validate the results derived from the analysis of the ten subsequent interviews with the SC-A and SC-B members.

Additional sources of data were websites, trade magazines articles and networking events to triangulate the collected data (Fauchart and Gruber, 2011). Data collection was carried on until no new information was obtained from additional interviews (Corbin and Strauss, 2008).

Prior to the interview each of the 14 informants received a letter of introduction, the research project description, and the interview guide (see Appendix 1) with four general interview questions (Corbin and Strauss, 2008): (1) What is the current level of SCI at your company?, (2) What are the reasons for the particular level of integration?, (3) Is there potential desire to improve the situation and why?, and (4) Could you provide examples of successful/less successful implementation of SCI? To not limit the interviews only to the integration with first-tier customers/suppliers, the informants were asked about SCI with SC members on a broad basis (i.e. including second-tier customers/suppliers).

Table 15 Overview of the interviews and additional sources of data

Interview	Company	Informants
Pilot Interviews		
1	Consultancy company X1	Partner (retail, manufacturing area)
2	Consultancy company X2	CEO
3	Manufacturing company Y1	Project manager
4	Manufacturing company Y2	Senior project manager
Key Interviews		
SC-A		
5	Focal company A	CEO
6	Focal company A	Purchasing manager
7	Focal company A	Senior sales and project manager
8	Focal company A	Logistics manager
9	First-tier supplier of focal company A	CEO
10	First-tier customer of focal company A	Purchasing manager
SC-B		
11	Focal company B	Supply chain manager
12	Focal company B	Sales and customer manager
13	Focal company B	Sales manager
14	First-tier customer of focal company B	Purchasing manager
Additional sources of data		
	SC-A	SC-B
Networking events	- event with 2 informants from FC-A (CEO, Logistics Manager)	- event with 2 informants from FC-B (SC and Logistics Manager) - event with 1 informant from first-tier customer B (CEO)
Public material	- websites; annual reports	- websites and catalogues; annual reports

3.4.3 Data analysis

The analysis process followed the guidelines of GT method as presented by Corbin and Strauss (2008). The major goal of the analysis was to derive theoretical constructs from the data that are “*grounded in the empirical data themselves*” (Charmaz, 2006: 2). The analysis included three rounds consisting of six steps (see Table 16).

The first round was about the initial data coding for each company within the studied SCs and included steps such as memo writing, open coding, and axial coding. The memo writing captured the initial thoughts about the data. Open coding included for each of the studied companies a) identification of all forms of external integration activities and related contextual factors, and b) identification of attributes of the integration activities and contextual factors. Axial coding considered development of clusters of contextual factors and associated integration activities identified at each company.

Table 16 Data analysis process

Analysis steps	Goal	Output
Analysis I		
1) Memo writing	Written records of the analysis	<ul style="list-style-type: none"> Initial thoughts about the data with respect to the research questions
2) Open coding	a) Concepts identification from interviews	<ul style="list-style-type: none"> External and internal contextual factors (CFs) for each company At least one integration activity for each factor Initial list of about 145 CFs and 300 integration activities
	b) Concepts development in terms of their attributes	<ul style="list-style-type: none"> The CFs and related integration activities were characterized by the informants by values representing magnitude of the factors (e.g. large/ high volume; low/ medium profit margins) respective intensity of integration (e.g. VMI – high level of integration) Assigning generic values (i.e. low, medium, high) to reduce the large variety of the magnitudes of factors and intensities of integration
3) Axial coding	Relating of the developed concepts on each company level	<ul style="list-style-type: none"> Initial clusters of internal and external CFs with associated integration activities for each company within the SCs as follows: <i>Companies in SC-A</i> <ul style="list-style-type: none"> FC-A (Products, Organization, Suppliers, Customers, Environmental uncertainty) First-tier customer (Products, Organization, Suppliers) First-tier supplier (Products, Customers) <i>Companies in SC-B</i> <ul style="list-style-type: none"> FC-B (Products, Organization, Suppliers, Customers, Environmental uncertainty) First-tier customer (Products, Suppliers, Environmental uncertainty)
Analysis II		
4) Data consolidation	Consolidation of the concepts on SC level based on conceptual similarities	Clusters of CFs and related integration activities for SC-A and SC-B are : Products, Organization, Suppliers, Customers, Regulations/ standards, Sustainability, Environmental uncertainty
5) Comparative analysis	Pattern identification between the identified CFs and integration activities in both SCs	<ul style="list-style-type: none"> Labeling low (1), medium (2) and high (3) values of CFs Labeling low (1), medium (2) and high (3) levels of integration activities Pattern identification such as CFs promoting establishment of an appropriate level of external integration (i.e. fit between CFs and levels of external integration); CFs challenging establishment of an appropriate level external integration (i.e. misfit)
Analysis III		
6) Integrating categories	Consolidating and refining of the findings into the resulting theoretical construction	<p><u>The consolidation process based on conceptual similarities</u> <i>Contextual factors promoting establishment of appropriate level of external integration</i></p> <ul style="list-style-type: none"> High product quality requirements, long/short lead time of raw mat/ components, high/low importance of suppliers, high/ low importance of customers, high requirements on certification/ validation, and high requirements on environmental sustainability. <p><i>Contextual factors challenging establishment of appropriate level of external integration</i></p> <ul style="list-style-type: none"> Initial stage of relationship, high need for innovation of products, distant channel position of key supplier from end-customer, high complexity of demand side, high requirements on supplier's flexibility <p><i>Level of external integration</i></p> <ul style="list-style-type: none"> High and low level with corresponding integration activities grouped in clusters such as relational, information sharing, and technology <p>Resulting theoretical construction – a set of eleven propositions and two matrices - depicting the contextual factors and their effect on level of external integration</p>

In the second round the coded data were consolidated based on conceptual similarities at SC-A and SC-B level and compared through data consolidation. Next, comparative analysis was carried out to identify patterns (i.e. contextual factors promoting or challenging establishment of an appropriate level of external integration) in the studied data. Finally, the last round of the analysis focused on integration categories through refining of the findings into the set of eleven propositions and two matrices.

3.5 Study 2 – Paper 3

The results of Paper 2 pointed out issues related to the misfit between contextual factors and level of external integration which are further scrutinized in Paper 3. The purpose of Paper 3 is thus to identify the possible reasons for why, despite theoretical predictions and potential performance benefits, some highly interdependent customer-supplier relationships are not highly integrated. The unit of analysis is the reasons for low level of external integration in interdependent customer-supplier relationships.

3.5.1 Case selection

From the original sample in Paper 2 (see Table 14), only cases were used in Paper 3 which demonstrated the misfit situation such as Case A (supplier: focal company A and customer: first-tier customer) and Case B (supplier: focal company B and customer: first-tier customer). Case A represents MedTech industry while Case B is from FMCGs industry.

Case A comprises of focal company A and first-tier customer. The focal company A is a surgical and medical component producer and a subcontractor manufacturing rather unique and innovative products, while the first-tier customer is an OEM, a global medical technology company. Case B includes focal company B and first-tier customer. Focal company B produces a packaging material for functional standardized products. First-tier customer is part of FMCGs sector with functional standardized products of large volumes.

To assess the representativeness of the cases in terms of high interdependence and low level of external integration the previously developed theoretical frameworks (see Table 6 and 7) were used and discussed in more details below.

High interdependence

Case A

Both actors in the Case A are exposed to high level of environmental and technological change due to the type of products which require on-going development of new technologies and materials, as presented in Table 17. Furthermore, the focal company A is dependent on the first-tier customer as a result of large percentage share of its total sales. On the other hand, the first-tier customer depends on the focal company A for the uniqueness and customization of their products for their needs. Yet another aspect leading to interdependency is the strict requirements on quality, reliability, traceability which necessitate certification and validation of processes, raw

materials and products. To meet this demand is very resource intensive for both actors. Consequently, it leads to reduced alternatives on market and to high switching costs. Each actor is expected to gain benefits from the relationship such as increased revenues and technological expertise. A long-term frame contract is signed between the actors to develop and maintain a long-term relationship.

Table 17 Interdependence characteristics of Case A and B

Interdependence related aspect	Case A	Case B
Environmental	High environmental uncertainty due to innovativeness of products	Low environmental uncertainty due to functional standardized products
	Limited alternatives available on market due to stringent requirements on certification and validation of product and processes	Focal company B has a few competitors on the Nordic market
	First-tier customer in the 10% of Supplier A key customers	High market entry barriers, requirements on low transportation costs and short lead times reduce number of potential alternative buyers/suppliers on the market
Exchange	First-tier customer accounts for 90% of focal company A total sales	70% of focal company A total sales is to first-tier customer
	Focal company A is subcontractor of first-tier customer on products currently not available on the market elsewhere	Economies of scale, market shares, limited alternatives on the market for both partners due to high market entry barriers
	Due to stringent quality requirements certification is necessary which is a time and resource consuming process for both actors	Due to low profit margins requirements on low transportation costs and short lead times reduce number of potential alternative on the market
	High switching costs	
	Knowledge, expertise, previous experience, maturity and quality of operations	Expertise, previous experience, operations maturity and quality due large costs of low quality; Focal company B is largest supplier of packaging material of first-tier customer
Relational	Neither has power advantages to alter the power balance; Limited alternatives on the market for both actors	Low power advantages of both to alter the situation; limited alternatives on the market for both actors
	Long duration of the relationship between both actors Long-term contract and frame agreements	Long duration of the relationship between both actors, developed routines and trust Long-term contracts and frame agreements

Case B

In Case B is characterized by low rate of technological change and low innovativeness as a result of low environmental uncertainty. On the other hand, both actors are exposed to high market entry barriers with economies of scale which is favorable for the large actors. Moreover, both actors experience high transportation costs in relation to the total costs of their products and to low profit margins. Thus, it is important for the focal

company B to locate its production site close to the plant of the first-tier customer.

Additionally, as there are few alternatives on market for both actors mainly due to limited raw material sources and large volumes both actors are mutually dependent. Both actors have signed long-term contracts as a result of satisfactory prior experience and expertise.

Low level of external integration

Case A

Case A exhibits the major low level of external integration in the Coordination of activity links (see Table 18). From focal company A's perspective, despite a large scope of exchange between partners, the focal company A lacks EDI connection to first-tier customer's ERP system. Even though the demand pattern of the end-customer is rather stable, the focal company A is provided by low quality demand forecasts from the first-tier customer. Moreover the quality of demand information from the customers is also negatively affected due to frequent changes in orders with short notice. The order sizes not always comply with agreed stock levels for the VMI consignment stock. Consequently, this leads to problems for the focal company A related to production capacity planning which impacts efficiency of internal operations. Also, considering high product quality requirements, performance feedback from the customer is insufficient to allow for early correction of operations in case of quality deviations.

However, from the first-tier customer viewpoint, the level of external integration with the focal company A related to information sharing is high. According to the customer, the access is offered to stock levels and product specifications. Long-term forecasts are provided for products with long lead times. The focal company is informed about planned changes in materials and components. Also, the focal company is part of discussions regarding new product planning and costs. Additionally, the customer offers financial compensation to the focal company A in case of unexpected order cancellation, but financial benefits are not shared.

Case B

In Case B there is also a low level of external integration mainly related to the Coordination of activity links dimension, followed by resource ties, and actors bonds (see Table 18). Due to low profit margins on their products, both actors focus on cost reduction. This can be done among other things through more efficient internal operations planning at the focal company B. To assist this initiative, the focal company would benefit from "point of sales" data provided by the first-tier customer. However, according to the

focal company, this information is not available. The customer makes frequent changes in orders as results of short notice promotions.

Table 18 Low level external integration in Case A and Case B

Dimensions	Case A	Case B
Coordination of activity links	<i>Focal company perspective</i>	
	Benefits are not shared	Risk is not equally shared due to low tolerance for loss
	Limited fast performance feedback, no POS data available for focal company A	No POS data received from first-tier customer (useful for large volumes products and volatile demand)
	Limited EDI connection: demand information from customer's internal portal (ERP) needs to be completed by data inserted manually by the focal company A	Low interest of first-tier customer in focal company's weekly operational reports in its internal portal
	Demand forecast provided to focal company A but with low quality	High fluctuation in quantities ordered due to unpredictable promotions; Low quality of demand forecast provided by first-tier customer
	<i>First-tier customer perspective</i>	
	Benefits are not shared	Risk is not equally shared due to low tolerance for loss; No access for focal company B to first-tier customer's ERP; No performance feedback provided to focal company B; Well established e-business solution with focal company B was terminated as the customer changed its ERP
Resource ties	<i>Focal company perspective</i>	
	X	Limited cooperation in innovations and new products development (NPD) to which impacts negatively efficient allocation of resources
		Contact limited only to first-tier customer's purchasing functions
		Deficiencies in internal integration at the first-tier customer have negative effect on NPD activities at focal company B
<i>First-tier customer perspective</i>		
X	No VMI consignment stock despite large volumes as the focal company B will not commit the related high costs	
Actor bonds	<i>Focal company perspective</i>	
	X	No business review meetings; No access to marketing department of first-tier customer and to end-customer

The demand forecast provided to the focal company B has a low quality and the order information via EDI needs to be often manually updated which increases administrative costs. Currently, the focal company lacks access to the customer's ERP system.

Concerning the low level of external integration in terms of the resource ties dimension, the focal company B pointed out a limited internal

integration (e.g. leading to design issues) at the customer. It impedes the operations at the focal company (e.g. shorter development and production time available for the focal company). Moreover, the focal company is not directly involved in the customer's new products development projects. The focal company's contact with the customer is mainly restricted to the purchasing department. However, the focal company would appreciate more input from the customer regarding innovations to enhance resource allocation. Also, risk is not shared as the customer claims low tolerance for loss. The first-tier customer expressed unwillingness of the focal company B to take risk relates to, for example, implementation of VMI consignment stock. Regarding the dimension of Actors bonds, the focal company perceives the current frequency of business review meetings with the customer as insufficient.

3.5.2 Data analysis

Within and cross-case analysis was conducted to identify the reasons for the low level of external integration, and benefits of enhancing the situation as stated by the informants. The aim of the cross-case analysis was to connect the results from the within case analysis to reveal patterns and to aggregate the results across the Case A and Case B (Yin, 2009; Miles and Huberman, 1994). Data collected during the process were matched with the theoretical framework (Krause and Ellram, 2014) to arrive at the proposed framework of reasons for low level of external integration in high customer-supplier interdependence.

3.6 Study 3 – Paper 4

In the previous research it is argued that there is a lack of process-oriented frameworks for evaluation of performance of the S&OP process (Thomé et al., 2012a). Moreover, the challenges for measuring the process performance were also insufficiently covered in the previous academic S&OP literature and performance measurement literature (Tuomikangas and Kaipia, 2014; Thomé et al., 2012a). Thus, the purpose of the third study was twofold: (1) to identify and structure the challenges of measuring performance of the S&OP process, and (2) to develop a framework for measuring the S&OP process performance. While the first purpose was addressed in Paper 4, the second purpose was dealt with in Paper 5.

To accomplish this, a multiple-case study methodology was selected. The motivation is the exploratory nature of the research with aim to increase understanding of the S&OP performance measurement practices and challenges (Yin, 2009). The unit of analysis is *challenges of measuring performance of the S&OP process*; and *performance measurement practices of the S&OP process*.

3.6.1 Case selection

In order to identify and structure the challenges of measuring performance of the S&OP process, the sample includes six companies representing different industries. The selection criteria were: 1) perceived current maturity level of their S&OP process, and 2) perceived importance of the process for their businesses. The final sample was extracted from a previously conducted survey by our department and which was answered by 63 companies. The companies that stated their perceived maturity level as (2), (3) and (4) following the Grimson and Pyke's (2007) framework (no company at the level (5) was identified in the survey), and that ranked themselves as level 8-10 on a scale 1-10 according to the second criterion were selected and invited via e-mail or phone to participate in the study. The final sample, then, included six case companies that agreed to be part of the study (see Table 19).

Table 19 List of the case companies and informants

Case companies	Engineering	InfoTech	Telecom	Energy	MedTech	Cosmetics
S&OP maturity level	2	3	3	3	4	4
Importance of S&OP process	10	10	10	8	9	9
Interviews (number/duration)	1/3 hours, 1/1 hour, 8/30min	2/ 2 hours	3/ 2 hours	4/2 hours	2/ 2 hours	1/ 2 hours
Title of the informants	Managers: Measurement/control, Sourcing, Plant, Logistics, Production, Quality, Customer serv.	Vice President Operations, Demand Manager	Managers: Demand Planning Process, Head of Demand, Improvement/ Performance	Managers: Regional material Group, Head of homecare, Marketing Intelligence, Market	Managers: Director Supply Chain (S&OP leader), Global Operations	Manager: Senior Director Global Business Development (S&OP leader)

(Hulthén et al., forthcoming)

3.6.2 Data collection

The data were collected via 22 structured face-to-face interviews, lasting between 0.5 hour to three hours, with informants directly involved or accountable for the S&OP process at each of the six case companies. The list of the informants is presented in Table 19. All the interviews were recorded and transcribed and are part of the research databases.

The case study protocol was reviewed by scholars for its clarity and comprehensiveness and pre-tested during a pilot interview (Krause and Ellram, 2014). After some modification the final version of the case study protocol (Appendix 2) was used during the subsequent interviews. The

protocol includes structured and semi-structured questions to guide the overall discussion (Yin, 2009). The questions capture the background of the companies followed by questions on challenges of measuring S&OP process effectiveness and efficiency (both terms were explained to the informants prior to each interview to avoid misunderstanding).

3.6.3 Data analysis

The within case analysis and cross-case analysis were applied to analyze the transcribed and coded primary data (Yin, 2009; Miles and Huberman, 1994). In Table 20, the within case analysis (Step 1 and 2) included separate coding of the responses for each individual interview at each of the case companies following our previously developed theoretical framework.

The aim was to identify challenges of measuring of S&OP process performance related to S&OP process effectiveness (i.e. corporate effectiveness and corporate efficiency) and S&OP efficiency. The results from each interview were then compared and consolidated into one representation of each case.

In Step 3, cross-case analysis, axial coding was applied to connect the results from the within case analysis across all the cases. This was done by searching for patterns. The findings were then aggregated across the six cases (Yin, 2009; Miles and Huberman, 1994). During the analysis process, several charts and tables were created and Pare parts of the research databases.

Table 20 Data coding and analysis steps

<p>Step 1: Initial data coding per source of evidence and identification of main themes</p>	<p>Interviews Challenges of measuring S&OP process effectiveness – business output</p> <ul style="list-style-type: none"> Challenges of measuring corporate effectiveness – customer satisfaction Challenges of measuring corporate efficiency – resource allocation <p>Challenges of measuring S&OP process efficiency – how well is the process managed</p> <ul style="list-style-type: none"> Organization of S&OP process 		<p>Documents Challenges related to presentation and visualization of S&OP measures in score cards, dashboards and charts.</p>
<p>Step 2: Open coding of measurement challenge for each case and maturity level (within case analysis)</p>	<p>Engineering Maturity level 2 <u>Corporate effectiveness</u> Extend planning; integrate measures in S&OP; include after-sales service measures; defining of trade-offs measures <u>Corporate efficiency</u> Integrate measures in S&OP; Sales measures priority; defining of trade-offs measures <u>Organization of S&OP process</u> S&OP measures not designed; monitoring of meeting efficiency; information preparation/ sharing, IT system</p>	<p>InfoTech Maturity level 3 <u>Corporate effectiveness</u> Baseline for customer service Level of details for forecast Trade-offs not defined <u>Corporate efficiency</u> New products related measures Trade-offs not defined <u>Organization of S&OP process</u> Linking service level and delivery measures to sales and their financial impact; IT system; monitoring of performance</p>	<p>Telecom Maturity level 3 <u>Corporate effectiveness</u> Level of details for forecast; supply plan adherence; cost of plans instability; total supply chain cost Trade-offs not defined <u>Corporate efficiency</u> New products related measures Trade-offs not defined <u>Organization of S&OP process</u> Supply planning in S&OP; link accountability and reward; information inconsistency; design of S&OP measures; baseline identification for measures; benchmarking and standardization of measures</p>
<p>Step 2: Open coding of measurement challenge for each case and maturity level (within case analysis)</p>	<p>Energy Maturity level 3 <u>Corporate effectiveness</u> Analyze of reasons for deviations in forecast accuracy Introduce supply measures Introduce profit measures Trade-offs not defined <u>Corporate efficiency</u> Cost reduction measures Trade-offs not defined <u>Organization of S&OP process</u> Interface between supply and demand; connection of S&OP measures to S&OP performance; link to strategy; information quality, availability and reliability; lack of meeting efficiency measures</p>	<p>MedTech Maturity level 4 <u>Corporate effectiveness</u> Customization of measures; cost of deviation between demand and sales plan; identification of low value products through forecast accuracy measures; Some key measures not yet synchronized cross-functionally <u>Corporate efficiency</u> Some key measures not yet synchronized cross-functionally <u>Organization of S&OP process</u> Less clarity in integration of measures with strategy and reward; monitoring of unplanned events; IT systems incompatibility</p>	<p>Cosmetics Maturity level 4 <u>Corporate effectiveness</u> Customization of measures; identify and monitor key measures; defining of trade-offs measures <u>Corporate efficiency</u> Customization of measures; identify and monitor key measures; defining of trade-offs measures; <u>Organization of S&OP process</u> Some key measures not yet synchronized cross-functionally; strategy goals less priority when key measures deviations occur Lack of measures to evaluate planning scenarios</p>
<p>Step 3: Axial coding to cluster conceptually similar challenges through pattern matching. Create high level categories across the cases (within and cross-case analysis)</p>	<p>Challenges of measuring S&OP process performance</p>		
	<p>S&OP process effectiveness</p>		<p>S&OP process efficiency</p>
	<p>Corporate effectiveness</p>	<p>Corporate efficiency</p>	<p>Organization of S&OP process</p>
	<p><u>Maturity level 2</u> Planning horizon Incorporation of measures into S&OP process; Cross-functional trade-offs <u>Maturity level 3</u> Standardization of measures; profit optimization ; supply related measures <u>Maturity level 4</u> Customization of measures</p>	<p><u>Maturity level 2</u> Incorporation of measures into S&OP process; dominance of sales measures; Cross-functional trade-offs <u>Maturity level 3</u> Cost reduction measures; new product development measures; cross-functional trade-offs <u>Maturity level 4</u> Customization of measures; cross-functional trade-offs</p>	<p><u>Maturity level 2</u> S&OP process implementation issues; meeting efficiency; information preparation and sharing <u>Maturity level 3</u> Alignment of measures with strategy and reward; cross-functional integration of plans; information preparation and sharing; visualization of measures; supply and demand planning in balance; meeting efficiency; measure plans <u>Maturity level 4</u> Alignment of measures with strategy and reward; visualization of measures; planning scenarios evaluation</p>

3.7 Study 3 – Paper 5

3.7.1 Case selection

In order to develop a framework for measuring the S&OP process performance, the sample included five companies from the original sample of six companies described above and used in Paper 4. The Engineering company was excluded from the sample as its S&OP process maturity level was too low (level 2) to provide sufficiently useful information relevant for the purpose of developing the framework. The sample of the studied cases is displayed in Table 21.

The sample was identified from the survey as discussed above on a basis of the same criteria as in paper 4 such as companies’ perceived maturity level of S&OP process and importance of the process.

Table 21 List of the case companies and informants

Case companies	InfoTech	Telecom	Energy	MedTech	Cosmetics
S&OP process maturity level	3	3	3	4	4
Importance of S&OP process	10	10	8	9	9
Interviews (number/duration)	2/ 2 hours	3/ 2 hours	4/2 hours	2/ 2 hours	1/ 2 hours
Title of the informants	Vice President Operations, Demand Manager	Managers: Demand Planning Process, Head of Demand, Improvement/ Performance	Managers: Regional material Group, Head of homecare, Marketing Intelligence, Market	Managers: Director Supply Chain (S&OP leader), Global Operations	Manager: Senior Director of Global Business Development (S&OP leader)

(Hulthén et al. 2016)

The final sample consists of five companies with experience, knowledge and interest in this applied research area such as Information Technology (InfoTech), Telecom, Energy, Medical Technology (MedTech) and Cosmetics. The selected cases demonstrate medium and high maturity levels. Three companies represent level 3, and two companies are at level 4. Moreover, two companies perceived the importance at level 10, two companies were at level 9, and one company indicated level 8.

3.7.2 Data collection

In total twelve interviews were conducted with people directly involved or accountable for the S&OP process at each case company. The number of informants and their functions varied across the cases (see Table 21). The

interviews were conducted face-to-face, recorded and transcribed. The interview protocol is presented in Appendix 2.

The interview protocol consists of background company information and questions regarding currently used measures of S&OP process effectiveness and efficiency. Associated with S&OP process effectiveness, informants were asked to list their current measures and indicate on a scale of 1 to 5 (1-strongly disagree; 5-strongly agree) the importance of the measures and motivate why they are/are-not critical. Similarly, related to S&OP process efficiency, the informants evaluated on a scale of 1 to 5 the degree to which different process oriented activities corresponds to their current situation. Additionally, the aim of these questions was to identify what activities were monitored or not monitored out of the activities in the S&OP efficiency section in the interview protocol. Finally, data on desired measures were also collected.

Additional data were collected to corroborate and augment the evidence from the interviews (Krause and Ellram, 2014). Archival data included copies of presentations and other material, such as a charts, process maps, consulting report and organizational websites.

3.7.3 Data analysis

The transcribed interviews were coded and analyzed by applying within case analysis and cross-case analysis, following similar structure as presented in Table 20 above. During the within case analysis, the responses were separately coded from each individual interview at each case company by following the key areas, S&OP process effectiveness and efficiency, from the initial theoretical framework. Then, the results were compared and synthesized into one representation for each case.

In the cross-case analysis, axial coding was used to link the results from the within case analysis across the cases. After a search for patterns and the findings were aggregated across the five cases in an iterative approach (Yin, 2009; Miles and Huberman, 1994). Collected primary data from the cases, archival secondary data, and the theoretical framework were combined to develop an understanding of the studied phenomenon (Krause and Ellram, 2014).

3.8 Research trustworthiness

Each of the three studies was evaluated based on the criteria relevant for the applied methodology including literature review, GT approach, and multiple-case study approach.

3.8.1 Study 1

The quality of the literature review can be assessed by a transparency of the review process. Transparency is achieved by explaining the way of searching for literature included in the review, choice of key words and sources used (Saunders et al., 2009; Tranfield et al., 2003). Yet another closely related quality criterion used was transferability. Transferability, conventionally known as external validity, has been advocated by several authors (e.g. da Mota Pedrosa et al., 2012; Halldórson and Aastrup, 2003) as applicable for qualitative research. This dimension of trustworthiness represents “*the extent to which the study is able to make general claims about the world.*” (Halldórson and Aastrup, 2003: 327). In other words, the degree to which the results of a study are relevant to other contexts.

In this study, the transparency and transferability was achieved by a detailed description of the research process and the unit of analysis, and by the comprehensiveness of the literature review (see Table 13).

3.8.2 Study 2

The research trustworthiness in Study 2 (see Table 22) has been judged by using in total 14 quality criteria for GT research as suggested by Corbin and Strauss (2008) and by Kaufman and Denk (2011) as follows: (1) *fit*: the credibility of the results and conclusions was reviewed by scholars and the informants, (2) *applicability*: the proposed external integration framework is considered to be applicable in practice by firms operating in industries with similar contextual characteristics and with various levels of external integration. The framework supports implementation of an appropriate level of integration with suppliers and/or customers given the discussed contexts, (3) *concepts*: the two main concepts of the framework (i.e. the contextual factors and external integration activities) are described, (4) *contextualization of concepts*: the major concept – context – is addressed thoroughly in relation to external integration activities, (5) *logic*: each aspect was elaborated to avoid missing links or gaps, (6) *variation*: the identified variation in findings relates to the misfits between contextual factors and level of external integration, (7) *depth*: the results are supported by thorough analysis and discussion including motivations and comparisons, (8) *creativity*: although, the topic is not new, the application of GT method is less common in logistics/SCM research and, thus, new insight can be obtained, (9) *sensitivity*: the influence by previous literature has been consciously reduced during the data collection and analysis, (10) *evidence of memos*: several memos were compiled and they are part of the research databases.

Table 22 Study 2: meeting quality criteria of GT approach

Quality criteria	Measures
Fit	<ul style="list-style-type: none"> Plausibility of results reviewed by scholars and informants
Applicability	<ul style="list-style-type: none"> Although the results need further testing, they can support practitioners in identifying and establishing an appropriate level of external integration activities with SC partners considering the discussed contextual factors
Concepts	<ul style="list-style-type: none"> The two main concepts such as contextual factors and external integration activities were described <ul style="list-style-type: none"> Contextual factors that organizations consider in both SCs when integrating with suppliers and/or customers were identified and discussed External integration activities: specific integration activities were presented and their various levels related to the identified contextual factors
Contextualization of concepts	<ul style="list-style-type: none"> The concept of context is a major topic and its effect on external integration is addressed
Logic	<ul style="list-style-type: none"> The main aspects of the concepts (i.e. contextual factors that promote or challenge integration, levels of external integration) were elaborated to not leave gaps or missing links
Variation	<ul style="list-style-type: none"> The variation in the findings was demonstrated by several misfits between contextual factors and levels of external integration
Depth	<ul style="list-style-type: none"> Results were thoroughly discussed, compared and motivated
Creativity	<ul style="list-style-type: none"> The topic of SC integration in relation to context is not new; however, applying the GT method is not common in integration literature. The application of this approach allowed for disclosing practitioners insights and issues.
Sensitivity	<ul style="list-style-type: none"> Through the process of data collection and analysis the attempt was to avoid influence by previous research
Evidence of memos	<ul style="list-style-type: none"> Memos are part of the research databases and are available upon request
Credibility	<ul style="list-style-type: none"> The relevance of the research purpose was ensured during the pilot interviews, but also by demonstrating a chain of evidence of how concepts were derived from data
Dependability	<ul style="list-style-type: none"> Multiple sources of data with different context (i.e. pilot interviews) were used to formulate the research purpose
Confirmability	<ul style="list-style-type: none"> The results were discussed with the informants to confirm the reflection of their reality
Transferability	<ul style="list-style-type: none"> The characteristics of the current cases are described and the observed contextual factors and integration activities is provided to enhance transferability to another context

There are additional criteria suggested by Kaufmann and Denk, (2011) which might partly overlap in some instances with the previous criteria such as 11) *credibility*: the pilot interviews supported the relevance of the research purpose. Also, the credibility was enhanced by using an established research design and by presenting a chain of evidence, during the analysis, on how concepts were obtained from data, (12) *dependability*: to formulate the purpose, multiple sources were used having different context (i.e. pilot interviews), (13) *confirmability*: the analysis is thoroughly described to demonstrate how the final constructs were created. Additionally, the results and conclusions were consulted with informants to confirm the reflection of their reality, and (14) *transferability*: the context of the studied cases is described.

3.8.3 Study 3

There are several criteria to ensure research quality for case study research such as construct validity, internal validity, external validity and reliability

(see Table 23) (e.g. Krause and Ellram, 2014; Yin, 2009; Gibbert et al., 2008).

Table 23 Case study quality criteria

Case study quality criteria	Actions
Construct validity	Peer researchers and external business executives review interview protocol Multiple sources of evidence used (part of the case study database): <ul style="list-style-type: none"> - Multiple informants representing supply and demand side of the S&OP to compare and contrast their responses - The terms of S&OP effectiveness measures and S&OP efficiency measures were explained to informants prior to each interview to avoid misunderstanding - Multiple sources of evidence (presentations, charts, reports, web-sites) to triangulate informants responses and augment the data - Receiving regular feedback from peer researchers on case analysis, results and tentative conclusions - The results were presented for informants and case companies representatives familiar with the studied phenomenon to check for validity
Internal validity	Pattern Matching <ul style="list-style-type: none"> - Multiple informants respond identically on a same phenomenon - Visualize the data to enhance cross-case analysis - Apply different previous literature (Supply chain performance measures, S&OP process performance measures) to interpret cross-case findings
External validity	Gathering rich data and a detailed case descriptions are provided so potential relating to other contexts is possible
Reliability	Case study protocol used: <ul style="list-style-type: none"> - Using an interview protocol for data collection across the cases - Developing an informants database - Developing and continuously updating a case study database (including interview transcriptions, codes and memos)

(Hulthén et al. 2016)

Construct validity was addressed by having the peer researchers review the interview protocol as well as by using multiple sources of evidence (i.e. several informants for each case, archival data). Moreover, regular feedback has been received from peer researcher on the process of analysis, results and conclusions. The results were presented for the case companies and discussed to confirm their validity. Internal validity was addressed through pattern matching which involved relating the observed pattern with pattern established in previous research. Additionally, triangulation was used to confirm the results by considering perspectives of multiple informants. External validity refers to providing a rational for case selection and detail description of the cases to allow for transferring the results to other contexts. The results of this study (i.e. framework of challenges of measuring the S&OP process performance, and framework for measuring the performance) can be used firms with similar industry characteristics and with various maturity levels of S&OP process. Considering reliability, to document the process of data collection and the analysis, research database was established including case study protocol, interview guide, recorded and transcribed interviews, and the data coding and analyses.

3.9 Methodological reflections

Associated with the literature review in Study 1, the major limitation represents the rather small sample of five reviewed SCM/logistics journals. Although, these journals were selected based on Gibson's et al. (2004) classification as being highly ranked in the field, it would be desirable to extend the search through databases to (e.g. ISI Web of Knowledge, Scopus, Ebsco) and keywords (e.g. supply chain integration, integration, collaboration, coordination, cooperation) instead. This would be desirable to ensure a better coverage of relevant papers across the field.

Related to Study 2, the Grounded Theory (GT) approach has been applied in this research to investigate the external integration. It represents a systematic, but flexible way of collecting and analyzing qualitative data to generate theories that are "*grounded in the empirical data themselves*" (Charmaz, 2006:2).

Although the GT method is not widely used in the field of logistics/SCM, it has slowly increased in popularity. GT has been applied to explore relatively less researched areas such as reverse logistics (e.g. Bernon and Rossi, 2011; Dowlatshahi, 2005) or sustainability issues (e.g. Signori et al., 2015; Flint and Golicic, 2009). It has also been used to develop frameworks and models describing relationships among supply chain actors (e.g. Boeck and Wamba, 2008; Garver and Mentzer, 2000).

Considering the discussed fundamental challenges in existing SCI research that have a negative effect on current status and development of existing theory, the GT approach was considered as particularly relevant method. The issues where this approach can be applicable include the lack of consistent terminology and a unifying definition, inconsistency between proven benefits and still limited implementation of the SCI in practice, and limited insight regarding the circumstances for integration.

This method proved to be beneficial in gaining understanding of the actual external integration practices. Moreover, it allows for grounding the emerging theory in empirics rather than just testing the existing theory. Therefore, as the application of GT in the field of logistics and SCM is still rather rare, its increased application in our field can be highly recommended to increase the still limited knowledge of the SCI, especially beyond the dyadic relationships.

Yet, the methodology can represent constraints related to the interpretation and coding of data. As stated by Corbin and Strauss (2008) the data could be obviously coded and interpreted somewhat differently by another researcher and result in another conclusion. The reason is that

different researchers might focus on different aspects of the data and identify meaning in data differently.

Another challenge of this approach, and also of the multiple case study approach used in Study 3, might be the rather limited size of the studied sample. However, considering the objectives of the GT approach which is to increase understanding of a studied phenomenon (Corbin and Strauss, 2008), this might be successfully achieved even by studying a small number of instances. It means that even a few cases may demonstrate concepts repeatedly to enable detection of patterns in the data.

The methodological limitation of Study 3 could be the absence of a case representing the highest maturity level of the S&OP. This would contribute to increase understanding of the challenges as well as the measurement of the process. However, such cases are rather rare in practice. Yet another reflection related to the sample selection refers to the fact that the companies were asked to evaluate themselves in terms of their perceived maturity levels of the S&OP process (using the framework by Grimson and Pyke, 2007) and its criticality for the case companies. Although the author could confirm after a thorough examination that the perceived maturity levels corresponded to the actual situation, this may be considered as a methodological limitation. Ideally, the evaluation should have been conducted by the researcher during the stage of case selection to avoid potential biases.

4. Summary of appended papers

In this chapter, each of the five papers is presented in terms of their respective purpose, and main contributions.

The purpose of this research is to *increase understanding of external and internal integration in supply chains, focusing on challenges and evaluation.*

The following five papers attempts to contribute to the purpose.

- P1: Näslund, D., and Hulthen, H. (2012). "Supply chain management integration: a critical analysis." *Benchmarking: An International Journal* Vol. 19, No 4/5, pp. 481-501. (Highly Commended Paper Award 2013 in Emerald Literari Network)
- P2: Hulthén, H. "A Grounded Theory based study of contextual factors and their effect on external integration in supply chains." (Under review in *International Journal of Logistics Management*)
- P3: Hulthén, H. and Pazirandeh, A. "Reasons for limited integration in highly interdependent buyer-supplier relationships: Insights from two cases." (Under review in *Journal of Purchasing and Supply Management*)
- P4: Hulthén, H., Naslund, D., and Norrman, A. "Challenges of Measuring the Sales and Operations Planning Process." (Accepted for publication in *Operations and Supply Chain Management: An International Journal*)
- P5: Hulthén, H., Naslund, D., and Norrman, A. (2016). "Framework for Measuring the Performance of the Sales and Operations Planning Process: A Multiple-case Study". *International Journal of Physical Distribution & Logistics Management*, forthcoming Vol. 46, No. 9, pp. 1-28.

The summary of the papers is presented in Table 24. It includes title, purpose, unit of analysis, method for each paper, as well as the main contributions of the papers. In the following sections, each paper is then discussed in more detail in terms of the purpose and main contributions

Table 24 Summary of the papers included in the PhD dissertation

	Study 1	Study 2		Study 3	
	P1	P2	P3	P4	P5
Title	Supply chain management integration: a critical analysis	A Grounded Theory based study of contextual factors and their effect on external integration in supply chains	Reasons for limited integration in highly interdependent buyer-supplier relationships: Insights from two cases	Challenges of Measuring Performance of the Sales and Operations Planning Process	Framework for Measuring Performance of the Sales and Operations Planning Process
Purpose	To examine various aspects of integration in order to structure and define the concept of supply chain management integration	To investigate the effect of contextual factors on external integration through exploring two objectives: (1) to identify contextual factors that companies consider when integrating with SC partners, (2) to identify external integration activities that companies establish with SC partners considering the contextual factors	To identify and structure the possible reasons for why, despite theoretical predictions and potential performance benefits, some highly interdependent buyer-supplier relationships are not highly integrated	To identify and structure challenges of measuring performance of the Sales and Operations Planning (S&OP) process	To develop a framework for measuring the S&OP process performance
Unit of analysis	Internal and external integration	External integration beyond dyads (first-tier suppliers; focal companies; first-tier customers)	External dyadic integration (buyers-suppliers)	S&OP process and challenges of measuring performance of the process	S&OP process and performance measurement practices of the process
Method	Literature review approach	Grounded Theory approach	Case study approach	Case study approach	Case study approach
Main contributions	a) Framework depicting the main aspects of SCI b) Limited empirical research on SCI beyond dyads to support the claimed benefits in previous integration research. c) Lack of detailed frameworks for evaluation of SCI	Development of a set of propositions and matrices depicting contextual factors that were observed to 1) promote establishment of an appropriate level of external integration, and 2) challenge establishment of an appropriate level of external integration	Identification and structuring of reasons related to skills and knowledge, relationship, transactions, and position in supply chain	Proposed process oriented framework to structure the challenges based on effectiveness and efficiency and different maturity levels of the S&OP process	Proposed process oriented framework for evaluating performance of the S&OP process based on the process effectiveness and efficiency

4.1 Paper 1

Purpose

The purpose is *to examine various aspects of integration in order to structure and define the concepts of supply chain management integration.*

Main contributions

The study identified and structured the main aspects that have been examined in previous SCI research. These are 1) scope of integration (i.e. internal, dyadic backward and forward, triadic, extended external integration, networks), 2) areas of integration (i.e. integration of functions, flows, processes, actors, and technologies), and 3) levels of relationship (i.e. arm's length, coordination, collaboration).

The literature review revealed that the most studied aspect of integration seems to be internal integration with focus on technologies or processes. Regarding levels of relationship, collaboration upstream is mostly represented in the reviewed papers.

Concerning the specific areas of integration that have been studied, the research on dyadic integration typically focuses on operational integration of functions and activities (e.g. logistics, marketing, operations, new products development), the triadic integration literature undertakes a more tactical and strategic perspective (including incentives alignment, supply chain design, partnership, and supplier/customer relationship management). While the literature examining extended external integration and networks discusses mainly strategic issues such as outsourcing, logistical and technological specialization, and culture.

This study further observed that previous research is limited in several aspects. There is a lack of empirical evidence supporting the benefits of SCI, especially beyond dyads. The current literature is rather scarce on detailed frameworks and recommendations for practitioners on how and why to integrate externally and internally. Additionally, this research confirmed existing SCI literature in that there is still limited empirically based research on integration beyond the dyadic scope (e.g. Fabbe-Costes and Jahre, 2008; Kemppainen and Vepsäläinen, 2003; Fawcett and Magnan, 2002) as well as a significant confusion in defining the concept of SCI (e.g. Stock and Boyer, 2009; Fabbe-Costes and Jahre, 2008; Mentzer et al. 2001).

4.2 Paper 2

Purpose

The purpose is *to investigate the effect of contextual factors on external integration.*

Main contributions

This study connects to the research emphasizing a need for in-depth studies on contextual factors which enable and inhibit external integration (Zhao et al., 2013) as well as their effect on selection of specific integration activities (Danese, 2011).

This research identified eleven contextual factors that the studied cases consider when integrating with their SC partners. Six of the factors were observed to promote establishment of an appropriate level of external integration (i.e. high product quality requirements, long/short lead time of raw materials and components, high/low importance of suppliers and customers, high requirements on certification and validation, and high requirements on environmental sustainability of products/processes). The remaining five factors (i.e. high need for innovation of products, initial stage of relationship, distant channel position of key supplier from end-customer, high complexity of demand side, and high requirements on supplier's flexibility) seem to challenge the establishment of an appropriate level of external integration. Eleven propositions and two matrices have been developed.

While several of the identified contextual factors were previously discussed in literature (Dyer et al., 1998; Fisher, 1997; Kraljic, 1983) this study can add factors such as high requirements on certification and validation of products and processes, and high requirements on environmental sustainability of processes and products. The data also show that the factors reported as challenging were stressed predominantly by suppliers. This situation occurred even despite of high interdependence between supplier and customer.

Moreover, several challenges of external integration were noticed and the potential consequences of the deficiencies on performance were discussed. Finally, the data confirmed previous research (e.g. Jayaram et al., 2010) in that integration in the cases can be described as dyadic.

4.3 Paper 3

Purpose

The purpose is *to identify and structure possible reasons for why, despite theoretical predictions and potential performance benefits, some highly interdependent buyer-supplier relationships are not highly integrated.*

Main contributions

This research builds on the theoretical prediction discussed in buyer-supplier integration literature that performance benefits can be gained when the level of integration between actors is matched with the level of their interdependence (e.g. Tuten and Urban, 2001; Kumar et al., 1995). However, several authors stressed that high interdependence is no guarantee for high level of integration (Gulati and Sytch, 2007; Caniëls and Gelderman, 2007; Narayandas and Rangan, 2004; Kumar et al., 1995). This study confirms and extends the findings of the previous research.

As a main result, a proposed framework of reasons for limited buyer-supplier integration in high interdependencies is developed. The framework also includes the potential negative effects on performance. The identified reasons are a result of matching existing literature and data from the studied cases. The reasons were grouped into four clusters such as *internal Skills and knowledge, Relationship, Transaction, and Position in supply chain.*

This research adds, to the reasons identified in previous literature (e.g. Kähkönen, 2014; Pero and Lamberti, 2013; Caniëls and Roeleveld, 2009), additional reasons observed in the studied cases such as incompatibility of communication channels, high demand complexity and uncertainty, buyer's expectation of supplier's expertise on products and process, and too far of a channel position to the end-customer. Moreover, the limited integration in both studied cases is demonstrated mainly by deficiencies in coordination of activity links (e.g. limited risk and reward sharing, low quality of demand information and performance feedback). The studied cases reported that by maintaining limited buyer-supplier integration despite being highly interdependent performance was negatively affected in terms of inefficiencies in operations, administration and planning.

4.4 Paper 4

Purpose

The purpose is *to identify and structure challenges of measuring performance of the Sales and Operations Planning (S&OP) process.*

Main contributions

This study highlighted that the existing research on challenges of measuring performance of the S&OP process is rather scattered (e.g. Grimson and Pyke, 2007) and the topic is discussed mainly in practitioners' literature and consultancy reports (e.g. Aberdeen Group 2009; Cecere et al., 2009; Lapede, 2005).

The main result is a process oriented framework for structuring the observed challenges founded on S&OP process effectiveness and efficiency – two major aspects of process performance (Neely, 1998). The study confirms previous research in that dominant challenges include focus on performance of individual functions rather than on performance of the process, use of too many measures, and lack of alignment of S&OP measures with business strategy and reward systems (e.g. Tuomikangas and Kaipia, 2014; Thomé et al., 2012a).

This study identified additional challenges such as Standardization, Customization, and Visualization of measures. However, the existing S&OP literature is rather limited in discussing these challenges as well as visualization of measures.

The results of the study are also founded on challenges for various S&OP maturity levels. Related to effectiveness and efficiency, more general challenges were identified as they occur at several levels (i.e. lower level to more advanced) such as Defining cross-functional trade-offs measures, Defining meeting efficiency measures, Information preparation and sharing, Alignment of measures with strategy and reward systems, and Visualization of measures.

Regarding the challenges of S&OP process efficiency, the major problems relates to cross-functional integration and process orientation. All studied cases stressed challenges of synchronizing all key S&OP measures cross-functionally through trade-offs and aligning them with business strategy and reward systems. This confirms partly the findings of, for example, Tuomikangas and Kaipia, (2014) and Grimson and Pyke, (2007).

4.5 Paper 5

Purpose

The purpose is to develop a framework for measuring the S&OP process performance.

Main contributions

The main contribution is the proposed framework which comprises of measures related to the two key areas of a process performance such as *S&OP process effectiveness* and *S&OP process efficiency* (Neely, 1998).

The framework addresses the lack of process-oriented approaches for evaluating the process performance, as stressed in previous S&OP literature (Thomé et al., 2012a; Ivert and Jonsson, 2010). All the main steps of the process and their related outputs are considered (Wagner et al., 2014; Jacobs et al., 2011).

The framework links to the overall performance of an organization referred to as corporate effectiveness and efficiency. It means that if the S&OP process is conducted well, the output of the process (i.e. S&OP plan) should meet the corporation's requirements on ROI target by increasing overall corporate effectiveness and efficiency. To attain this, *S&OP process effectiveness* and *efficiency* are vital. While the first one relates both to corporate effectiveness and efficiency by indicating how the S&OP plan influences corporate effectiveness and efficiency, the process efficiency means how well is the process managed. The framework considers challenges of measuring the S&OP process effectiveness and efficiency.

The framework attempts to adhere to the performance measures criteria suggested in previous research (e.g. Caplice and Sheffi, 1995). The multiple perspectives on the measures (i.e. financial, customer satisfaction, quality, flexibility, timeliness, innovativeness, and learning) relates to the criterion of *comprehensiveness*. The suggested measures of S&OP process efficiency (i.e. process, organization, and people) address the *internal process efficiency* criterion. The discussion on cross-functional trade-offs measures and their integration with business strategy and reward systems relates to the criterion of *horizontal and vertical integration* of measures. By using both financial and non-financial measures the *internal comparability* was handled. Finally, by restricting the number of measures, the *usefulness* criterion was considered.

5. Results

This chapter summarizes and discusses the results related to the research objectives.

5.1 Summary of the results

The purpose of this research was *to increase understanding of external and internal integration in supply chains, focusing on challenges and evaluation*. To accomplish this purpose, three research objectives have been formulated and three studies were conducted to address the objectives:

RO1: *To identify challenges of Supply Chain Integration.*

RO2: *To propose a context-based framework for evaluation of external integration.*

RO3: *To propose a framework for performance evaluation of the Sales and Operations Planning (S&OP) process.*

In the following, the answers to the three objectives will be presented.

RO1: To identify challenges of Supply Chain Integration

The identified challenges of Supply Chain Integration distinguish the challenges of *external integration* and *internal integration* (the S&OP process).

Challenges of external integration

The observed challenges of external integration were predominantly experienced by suppliers. The suppliers had a rather clear idea about what level of external integration (i.e. intensity of integration) would be appropriate to establish, considering the specific contextual factors, with their first-tier customers. However, they reported difficulties to achieve that level of integration. Difficulties occurred even when there is a high level of interdependence between the actors (i.e. focal companies and first-tier customers) due to limited market alternatives and high market entry barriers.

Recalling Structural Contingency Theory (SCT) (e.g. Flynn et al., 2010; Skipper et al., 2008; Stonebraker and Afifi, 2004), it is suggested that factors representing organizational context should be scrutinized to determine an appropriate level of integration. Ideally, improved performance can be achieved by matching the level of external integration to contextual factors. This would indicate a *fit*. On the other hand, if there

is deviation between the contextual factors and the applied level of integration, there is a *misfit* (i.e. inappropriate level of integration is used considering the context). A misfit could have a negative effect on performance.

In Figure 7, the observed levels of external integration are high and low. Each level is characterized by a set of integration activities clustered into three groups: *relational*, *information sharing*, and *information technology* (The three groups were identified and developed in Study 2 and reported in paper 2.) The high level of integration included integration activities such as cross-firm planning, business review meetings, supplier development programs, SC financing and long term contracts, regular performance feedback, and access to partners' information systems. The low level of integration included limited cross-firm review meetings, short-term contracts, limited performance feedback, and traditional order handling.

Five observed contextual factors challenge the establishment of an appropriate level of external integration between SC partners: *high need for innovation of products*, *distant channel position of key supplier from end-customer*, *high complexity of demand side*, *high requirements on supplier's flexibility*, and *initial stage of relationship*. The previous literature addresses some of the identified factors such as need for innovativeness (Wong et al., 2015; Lamming et al., 2000), channel position in supply chain (Lee et al., 1997), and complexity and flexibility (Power, 2005) as leading to high level of integration. However, the results of this study indicate that these contextual factors also might represent a challenge for achieving an appropriate level of external integration. As a result a *misfit* can occur between the contextual factors and the applied level of external integration.

To illustrate, the contextual factor of *high need of innovation of products* would, according to the informants, require a high level of external integration to facilitate the innovation process (e.g. cross-firm planning and innovation meetings including direct contact between supplier's and customer's sales/marketing functions). However, the contact was not permitted by the customer and innovation meetings did not take place.

Contextual factors challenging appropriate level of external integration

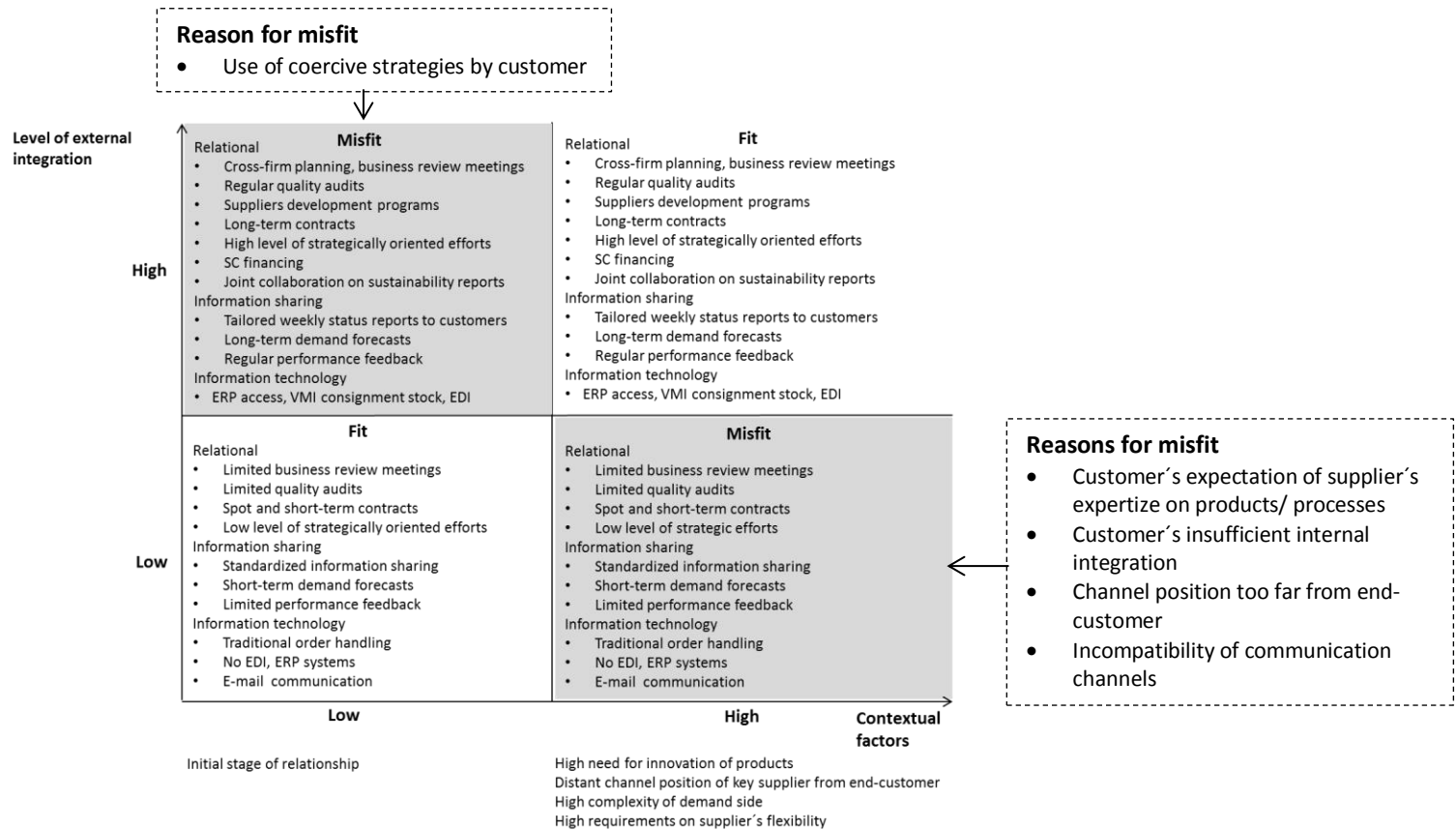


Figure 7: Contextual factors proposed to challenge establishment of appropriate level of external integration and reasons

The contextual factor of *distant channel position of key supplier from end-customer* was observed to negatively impact the quality of information sharing upstream. For example, to receive high quality demand forecasts for new products might be difficult, however, timely and reliable information of end-customer real demand could decrease the demand uncertainty, as expressed by suppliers.

Additionally, providing the supplier with performance feedback as soon as deviation from required specification or quality occurs was also emphasized. By doing so, quality issues could be quickly resolved. The low frequency of the feedback does not consider the above described need to be an efficient tool for improving performance.

The contextual factor of *high complexity of demand side* is associated with scope of output and number of actors. According to the suppliers, the high complexity would require closer collaboration with customers (e.g. EDI, access to customer's ERP system, and high quality of demand forecasts). For example, the suppliers stressed insufficient use of information technology such as limited access to key customers' ERP systems.

The contextual factor of *high requirements on supplier's flexibility* relates to the observed limited availability of demand information from customers due to frequent changes in orders and the low quality of demand forecasts. The quality of information sharing is vital when requirements on supplier flexibility are high.

The contextual factor of *initial stage of relationship* refers to a situation when suppliers might be forced to implement, for example, VMI consignment stock even if such investments might be risky, for example in an initial stage of a relationship with a customer. In the initial stage of a relationship the supplier would prefer to use a traditional order handling system. In a more mature stage of the relationship an investment in VMI consignment stock would be more reasonable, according to the informants.

Moreover, five reasons for the misfits were identified and discussed. Three of the reasons were previously addressed in literature: *insufficient customer internal integration* (Cox et al., 2004), *channel position too far from end-customer* (Lee et al., 1997), *use of coercive strategies* (Caglio and Ditillo, 2012). This research adds two more reasons: *customer's expectation of supplier's expertise*, and *incompatibility of communication channels*.

Customer's insufficient internal integration depicts the situation where the deficiencies in the customer's internal integration negatively impact product design and operations planning at the supplier. *Channel position too far from end-customer* refers to a situation when the low quality of demand information is the result of many intermediaries between the end-

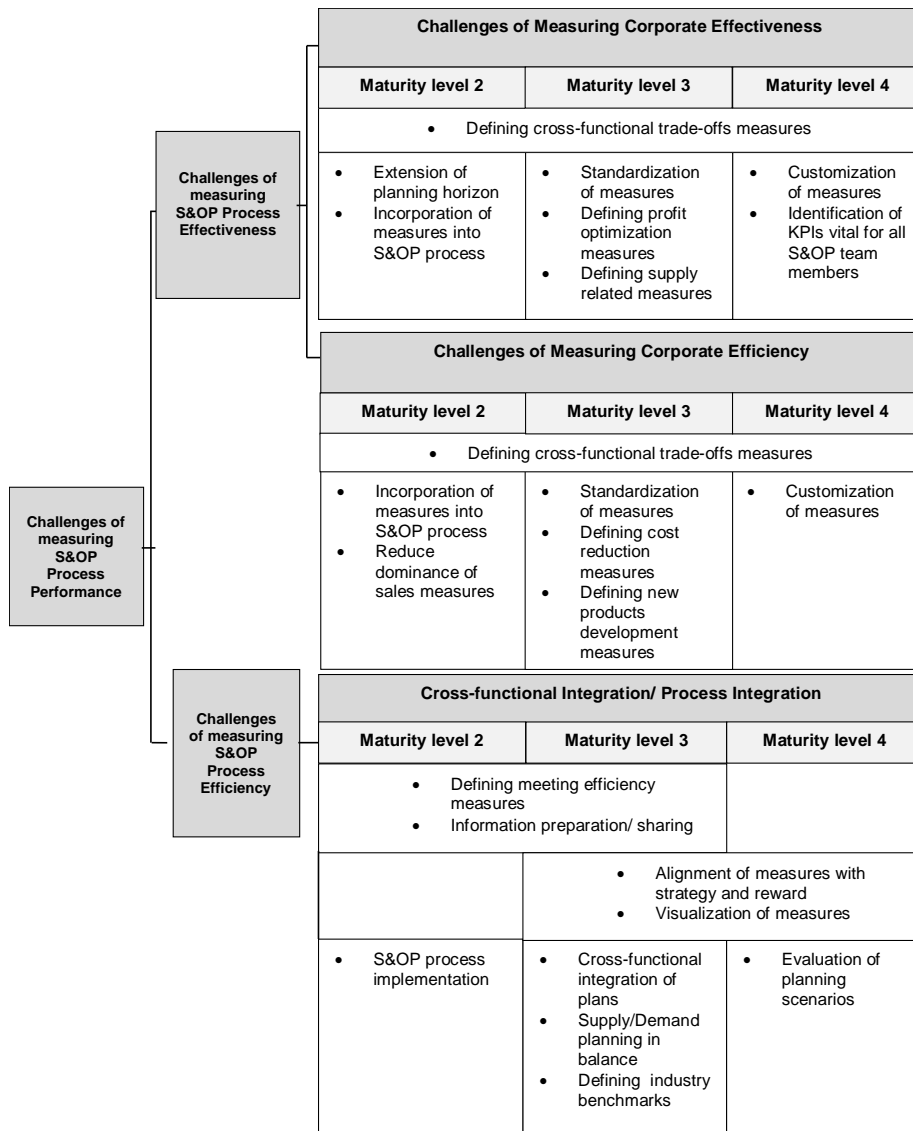
customer and the supplier. This leads to deterioration of the real demand information and to frequent changes in orders with short notice. *Use of coercive strategies by customer* relates to requirements on implementation of VMI consignment stock at the supplier. By doing so, the customer influences the supplier to gain desired terms and compliance. *Customer's expectations of supplier's expertise on products/processes* refer to a situation when a supplier desires cross-functional innovations meetings with the customer to better comply with the customer's expectations. However, the customer is less favorable to such meetings as it perceives the supplier being an expert and thus fully responsible for the innovations. Associated with *incompatibility of communication channels*, it was observed that suppliers often had insufficient access to the customer's information systems. Despite their interdependence, lack of such access can negatively affect the integration and lead to operational and planning inefficiencies at both partners.

Challenges of Sales and Operations Planning (S&OP) process

The evaluation of performance of the S&OP process is difficult due to limited understanding of the challenges related to evaluating the S&OP performance. This research identified and clustered several challenges to evaluating performance of the S&OP process based on: 1) two main areas of a process performance – *S&OP process effectiveness* and *efficiency*; and 2) various maturity levels of the process implementation at companies, as presented in Figure 8.

Several challenges from previous literature were confirmed, for example, designing of cross-functional trade-offs, and the alignment with business strategy and reward systems (Tuomikangas and Kaipia, 2014; Thomé et al., 2012a; Grimson and Pyke, 2007), evaluation of planning scenarios (Cecere et al., 2009), and reducing the dominance of demand measures over supply measures (Grimson and Pyke, 2007).

The research also identified new challenges such as standardization, customization, and visualization of measures. Moreover, several challenges were detected across numerous maturity levels which indicates how difficult it might be to address them (e.g. defining cross-functional trade-offs, defining meeting efficiency measures, information preparation and sharing, alignment of measures with strategy and reward systems, and visualization).



(Hulthén et al., forthcoming)

Figure 8: Challenges of measuring the S&OP process performance

Challenges of measuring S&OP process effectiveness

Related to measuring S&OP Process effectiveness, two groups of challenges were distinguished: challenges of measuring corporate effectiveness (i.e. related to customers' satisfaction) and corporate efficiency (i.e. allocation of resources).

The major challenge in both groups was to *define cross-functional trade-offs measures* to balance the demand and supply side. Only one case had developed this type of measure. This challenge is not only associated with lower maturity levels (i.e. level 2 and 3), as suggested by Wagner et al. (2014) and Grimson and Pyke (2007), but this research indicates that it is prevalent even at more advanced maturity levels (i.e. level 4).

Additional challenges to measuring **corporate effectiveness** at maturity level 2 are of a more basic nature, such as *extension of planning horizon* (i.e. extending the monitoring of the planning beyond short-term reactive reporting to identify future trends and threats), and *incorporation of measures into the S&OP process* (Bower, 2005; Lapide, 2004)..

Challenges identified at maturity level 3 are more sophisticated, including *standardization of measures*, *defining profit optimization measures*, and *defining supply related measures*. Standardization of measures concerns how to establish a standardized level of detail (i.e. considering different time horizons, product granularity and product segments) to be used across the organization when monitoring, for example, forecast accuracy. This is important to avoid misunderstanding of the current situation and to support unbiased decision making.

Defining profit-related measures is observed already at level 3, while literature links this challenge with the highest advanced level 5 (Grimson and Pyke, 2007). This suggests that for organizations, even at lower levels, one of the major goals of implementing the S&OP process is to enhance profit. Associated with the challenge of *defining supply-related measures*, the cases at level 3 lacked supply-related measures such as supply plan adherence. Instead, they focused on demand-related measures.

The level 4 cases emphasized also a rather advanced challenge of *customization of measures* for different organizational groups and levels. Moreover, they struggled with *identification of KPIs vital for all S&OP team members*.

Concerning challenges of **corporate efficiency**, at level 2, the previously observed challenge of *incorporation of measures into S&OP process* also applies for corporate efficiency alongside with the challenge to *reduce dominance of sales measures* (Grimson and Pyke, 2007). At level 3, the cases experienced challenges of *standardization measures*, *defining cost*

reduction measures, and defining new product development measures. While standardization was discussed above, defining cost reduction measures refers to measuring the cost reduction as a result of improved capacity utilization through the S&OP process. Defining new product development measures would require monitoring of, for example, product life cycles to reduce obsolete inventory and lost sales (Bower, 2005). At level 4, similarly to corporate effectiveness, the challenge of *customization of measures* was observed.

Challenges of measuring S&OP Process Efficiency: Cross-functional Integration/Process orientation

Similarly to effectiveness, there are challenges that are common for several maturity levels. *Defining meeting efficiency measures and information preparation and sharing* are challenges that were identified at levels 2 and 3. Challenges of *alignment of measures with strategy and reward systems, and visualization of S&OP measures* are associated with level 3 and 4.

Regarding the defining meeting efficiency measures, two issues were identified that differ with the maturity levels. At level 2, the efficiency measures (e.g. attendance at meetings, pre-meeting work done on time) were not monitored due to difficulties to even implement the S&OP process. The level 3 cases regarded the measures as redundant as they follow strict routines regarding e.g. attendance and planning frequency. The challenge of information preparation and sharing is associated with deficiencies of currently used IT systems (e.g. several incompatible systems). The IT systems lack sufficient capability to measure the process performance. The benefits would be enhanced information consistency, reliability and availability, as stressed by cases at levels 2 and 3.

The common challenge at levels 3 and 4 is alignment of measures with strategy and reward systems. This challenge is directly linked to the previously discussed problem of defining cross-functional trade-offs measures and then aligning them with strategy and reward systems (Toumikas and Kapipia, 2014; Wagner et al., 2014). The challenge of visualization of S&OP measures is related to lack of an appropriate IT system that would assist preparation and analysis of the measures in terms, for example, of reasons for deviations from targets.

An additional challenge observed at level 2 is *S&OP process implementation*. This is of a fundamental nature and needs to be resolved prior to establishment of performance measures (Wagner et al., 2014; Grimson and Pyke, 2007). At level 3, challenges of *supply/demand planning in balance, cross-functional integration of plans, and defining*

industry benchmarks were identified. Including supply related measures is problematic even at a more mature level. Lack of such measures can negatively impact the evaluation of balance between the supply and the demand plan. The insufficient interface between the supply plan and the demand plan (e.g. relation between planned service level, on time delivery, sales and profit targets) is also reflected in the challenge of cross-functional integration of plans (Grimson and Pyke, 2007). The challenge of defining industry benchmarks emphasizes lack of industry benchmarks to allow for comparison of the S&OP process performance against other companies in similar industries (Wagner et al., 2014). Finally, a challenge that was detected at level 4 is *evaluation of planning scenarios* (Cecere et al., 2009). This captures difficulties in identifying appropriate measures for evaluation of various planning scenarios. This would allow, for example, the reduction of stock outs during promotions.

RO2: To propose a context based framework for evaluation of external integration

The proposed framework for evaluation of external integration (see Figure 9) consists of six contextual factors and corresponding levels of external integration. The six contextual factors represent factors that were commonly considered by the studied cases when determining the level of integration with their SC partners. The factors are *high product quality requirements*, *long/short lead time of raw materials/components*, *high/low importance of suppliers*, *high/low importance of customers*, *high requirements on certification/validation*, and *high requirements on environmental sustainability of products/processes*. These factors were observed to promote establishment of an appropriate level of external integration (either high or low) and thus they would lead to a *fit*. The fit occurs when a contextual factor is matched with an appropriate level of external integration (e.g. Donaldson, 2001).

The observed integration activities were grouped into three clusters: relational aspects (e.g. Richey et al., 2009), information technology, and information sharing (e.g. Boon-itt and Wong, 2011; Zhao et al., 2011).

Contextual factors promoting appropriate level of external integration

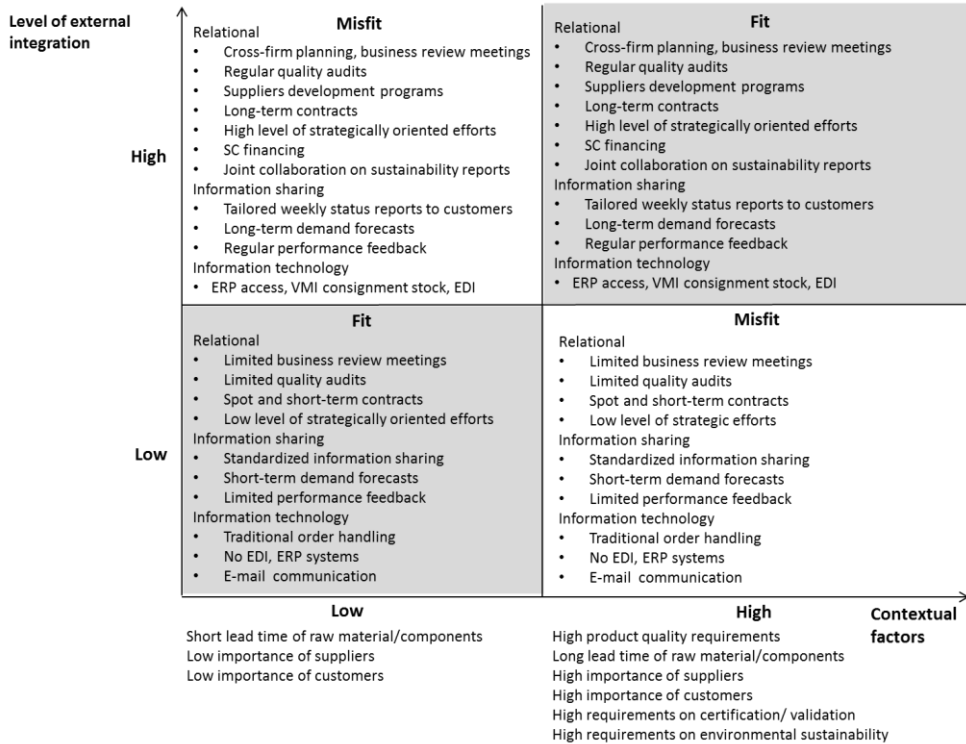


Figure 9 Contextual factors proposed to promote establishment of appropriate level of external integration

Some of the contextual factors were previously discussed in literature, such as product quality requirements (Dyer et al., 1998; Cooper et al., 1997), lead time of raw materials/components (Dyer et al., 1998; Fisher, 1997), importance of suppliers (Power, 2005; Fisher, 1997; Kraljic, 1983) and importance of customers (Danese, 2011; van Donk and van der Vaart, 2005). However, this research identifies additional factors such as high requirements on certification/validation of products/processes, and high requirements on environmental sustainability of products/ processes.

Moreover, the factors of high product quality requirements, long/short lead time of raw material/components, high/low importance of suppliers, and high/low importance of customers were observed both at cases with functional and innovative products. While the factor of high requirements on certification/validation of products/processes was identified in the case with innovative products, the factor of high requirements on environmental sustainability of products/processes was related to the case with functional products.

The proposed framework may support decisions on what level of integration to establish considering the contextual factors. Not all of the relational, information sharing, and information technology aspects of external integration need to be applied. Their relevance depends on the organization's specific practices.

For example, for the contextual factor of *high product quality requirements*, the requisite level of external integration would be high as well. This could be characterized by e.g. long-term relationships and using stringent requirements when selecting suppliers, alongside regular quality audits at key suppliers or those suppliers with severe quality issues. Similarly, the contextual factors of *long/short lead time of raw materials/components* also affect the level of integration. A high level of integration is established with key suppliers of raw materials/components with long lead time. An example of an integration activity is sharing long-term demand forecasts with suppliers. The suppliers then send customers tailored weekly updates on status and location of stock levels. On the other hand, with suppliers of items with short lead time, a low level of integration is used, such as standardized information sharing.

The contextual factor of *high/low importance of suppliers* relates to importance in terms of volumes, value, and frequency of purchasing. High level of integration is established when there is high level of supplier importance. This entails integration activities such as a rigorous supplier selection process, interest in developing and maintaining long-term relationships between supplier and customer through, for example, supplier development programs, and regular joint business review meetings to discuss innovations and future plans and to resolve potential issues. When sourcing and delivery reliability is critical, then the customer provides high quality demand forecasts to the key suppliers. The important suppliers also might have access to the customer's ERP systems. Contrarily, the customer allocates considerably fewer resources to managing relationships with suppliers of less importance.

Similarly to the previous discussion, the contextual factors of *high/low importance of customers* are considered in the relation to the level of external integration. For customers with high profit margins, high sales volumes, value or high frequency of purchasing, a high level of integration is established. These customers receive attention as they account for a large portion of total turnover, or they possess a significant expertise in a critical area. Activities include VMI consignment stock and having suppliers invest considerable resources to manage these relationships in terms of time, overhead costs, and regular visits. Also, key account managers are assigned to work strategically with the customers. On the other hand, with less importance the level of integration is low; it consists of activities such as

operational assistance when needed or a traditional order handling process. Moreover, the supplier allocates limited resources to manage those customers. There is neither EDI nor VMI due to the small volumes and the perceived lack of return on investments.

The contextual factor of *high requirements on certification/validation of products/processes* encourages high level of external integration. The high requirements were reinforced either by regulations in, for example, the medical technology industry or by absence of process quality standards (e.g. ISO). This motivates involved partners to maintain long-term relationships as well as to conduct regular visits and audits to ensure required standards.

Finally, the contextual factor of *high requirements on environmental sustainability of products/processes* resulted in a high level of external integration. One illustration is the close interaction to compile sustainability reports for authorities. The SC partners can also represent each other's interest in contact with the authorities.

RO3: To propose a framework for performance evaluation of Sales and Operations Planning (S&OP) process.

The proposed framework for evaluation of the S&OP process performance (see Figure 10) is based on the key areas of S&OP process effectiveness and efficiency, the individual process steps and their outputs as well as the output of the entire process.

Regarding the *S&OP process effectiveness measures*, in Step 1 it is important to monitor the input data quality in terms of reliability, timeliness, and availability.

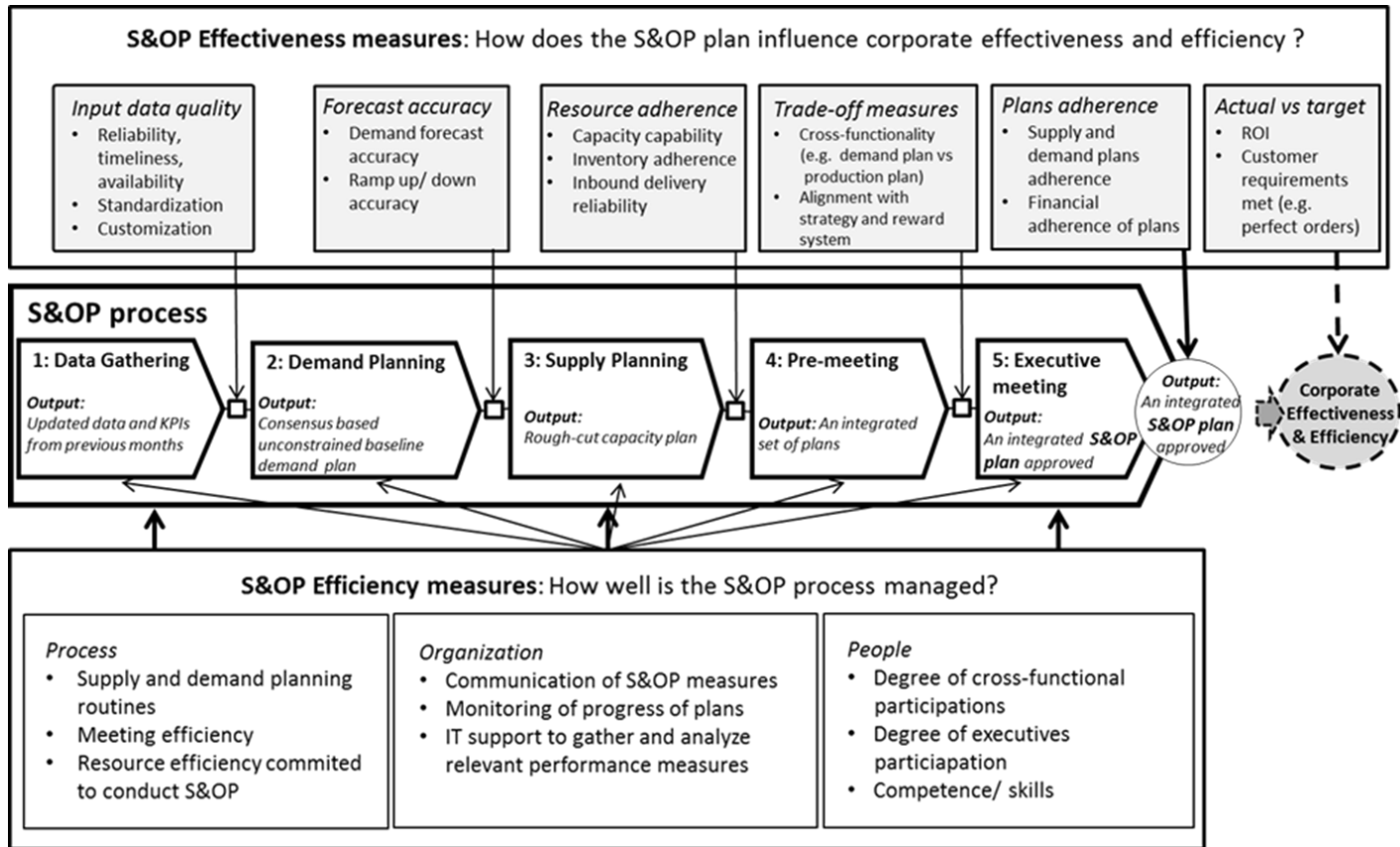


Figure 10 A proposed framework for evaluation of the S&OP process performance

Standardization of the components is included in the measures (e.g. different time horizons, product granularity, and market segments) to avoid biased decision making.

In Step 2 the aim is to arrive at an unconstrained demand plan, which is often monitored through demand forecast accuracy. It is suggested to consider all known information that might have impact on the demand. Examples include information related to new products development and obsolete inventory. Additionally, companies with rather innovative products might include a measure of ramp up accuracy (i.e. launches of new products) and ramp down accuracy (i.e. phasing out products).

To evaluate the output of Step 3, the proposed key performance indicators include capacity capability (e.g. capacity utilization), inventory adherence, and inbound delivery reliability. In Step 4, an integrated set of plans is developed through balancing the demand and supply plans. The suggested measures of this step are a set of cross-functional trade-offs such as demand plan versus production plan, actual inventory levels versus inventory targets, and inventory levels versus capacity levels. Moreover, it is argued that the trade-offs measures need to be aligned with business strategy and reward systems to improve business performance and to prevent deviation from the strategy (Bourne et al, 2003; Ittner and Larcker, 2003).

In the final Step 5, the goal is to arrive at an approved S&OP plan. As the step involves financial reconciliation of plans and comparing the plan to the financial targets of the business, the proposed measures consist of indicators of adherence to financial performance of plans versus business targets, supply plans (i.e. operations plans) and demand plans (i.e. sales and marketing plans).

The approved S&OP plan is the output of the process and it should influence both corporate effectiveness and efficiency and thus overall business performance. To evaluate the plan, multidimensional measures are advocated (Thomé et al., 2012a). To assess the plan's impact on corporate effectiveness (i.e. customer satisfaction) and corporate efficiency (i.e. resource allocation), a measure of actual return on investment (ROI) versus target can be applied. Another potential measure is "customer requirements met", which captures perfect orders versus target.

Concerning *the S&OP process efficiency measures* of how well the process is managed, the identified measures can be grouped into three categories: *process*, *organization*, and *people*. The proposed measures can be used to evaluate each of the process steps as well as the whole process.

Process related measures refer to supply and demand planning routines, which might include evaluation of planning scenarios, meeting efficiency measures (e.g. attendance of S&OP team members at meetings, pre-meeting work done on time, re-planning frequency), and resources committed to conduct the process.

Organization measures focus on communication of S&OP measures and the indicators can be, for example, regular communication of measures throughout the organization, monitoring of progress of plans (e.g. unplanned events are monitored, and the ability to respond to the events in a timely manner), and appropriateness of supporting IT systems. Finally, the people category captures the cross-functional involvement at the S&OP meetings, executive participation, competence and skills of the team members, and establishment of the process owner with clear division of responsibilities.

The measures included in the framework comply with several criteria (Caplice and Sheffi, 1995) on appropriate performance measures such as comprehensiveness given by the multiple perspective of financial (ROI) and non-financial measures (i.e. customer requirements met); internal process efficiency (i.e. measures of process, organization, and people); horizontal and integral integration (i.e. cross-functional trade-offs measures aligned with strategy and reward systems); internal comparability (i.e. financial and non-financial trade-offs measures), and usefulness (i.e. limited amount of key measures). Also, the proposed measures are multidimensional as they capture aspects of quality, cost, flexibility, timeliness and innovativeness, and learning (Shepherd and Günter, 2006; Brewer and Speh, 2000).

6. Conclusions, contributions and future research

This chapter gives a concluding discussion and presents theoretical and managerial contributions. Finally, several future research opportunities are suggested.

6.1 Concluding discussion

The purpose of this research is to *increase understanding of external and internal integration in supply chains with a focus on challenges and evaluation*. The findings indicate that despite a considerable amount of research on SCI and advancement in practice, many organizations still experience several challenges when it comes to integration in practice. While several of the challenges discussed in this thesis have been included in prior theory, new challenges were also identified. This suggests that in theory and practice, the old and new challenges require closer attention in order to develop guidelines that would better assist organizations in dealing with these challenges. This thesis attempts to contribute to this task.

Related to external integration, organizations still struggle to identify and establish the right type of relationship with the right partner. This corresponds to, for example, recent research by Fawcett et al. (2015). The findings of this thesis indicate that suppliers often find it difficult to establish an appropriate level of integration with customers. Several contextual factors were identified that challenge development of an appropriate level of external integration. Even though many of the factors have been previously studied (e.g. by Caglio and Ditillo, 2012; Cox et al., 2004; Lee et al., 1997), this research shows that they are still problematic in practice.

Furthermore, since one criticism of existing integration research is that the unit of analysis has been the single organization or the dyadic perspective (Fabbe-Costes and Jahre, 2008) the intention of this research was to study external integration from the perspective of two supply chains including three actors. However, integration in the studied cases can best be described as dyadic, which corresponds to previous research (Jayaram et al., 2010). The only examples of integration beyond dyads took place when it was needed to secure valuable strategic resources (e.g. raw material). However, in such cases the customer had direct contact with the 2-tier supplier, while the 1-tier supplier was not involved in the interaction.

Regarding the S&OP process, the observed challenges of measuring the S&OP process performance include both basic and more complex aspects. Several challenges were also common across multiple maturity levels.

Concerning the evaluation of external integration and the S&OP process, it is desirable to attain a balanced evaluation approach. A balanced evaluation approach means simultaneously evaluating both external and internal integration as they are linked. The link between the external and internal integration means that through external integration (demonstrated by, for example, multiple functional interfaces, delivery and sourcing systems, investments in assets, information sharing on plans, capacity and inventory) an organization can obtain demand and supply related information from its SC partners. This information then ideally allows an organization to enhance its internal planning through balancing of demand (e.g. improved quality of demand forecasts) and supply plans (e.g. improved operations planning, reduction of capacity shortfalls). However, to do so an internal integration needs to be established, for example through the Sales and Operations Planning (S&OP) process. In turn, the planning information can then support organizational planning at suppliers and customers.

To support the evaluation of external integration and the S&OP process, a framework for external integration and its potential effect on the S&OP process performance is proposed (see Table 25). The framework synthesizes the findings of this research. It includes the contextual factors considered by the cases when integrating with SC partners. The factors are then matched with an appropriate level of external integration (i.e. high, low) and linked with specific measures of the S&OP process effectiveness they can potentially affect.

For example, for *high complexity of demand side* (i.e. scope of output and number of actors), an appropriate level of integration between the supplier and the customer should be high (i.e. closer collaboration with EDI, access to customer's ERP system to, for example, monitor inventory levels, and high quality of demand forecasts). Consequently, this level of external integration is expected to positively influence S&OP process effectiveness measures such as forecast accuracy, resource adherence, trade-offs measures, plans adherence, actual versus target performance.

Table 25 Framework for external integration and its effect on S&OP process performance

Contextual factors	Appropriate level of customer-supplier integration	S&OP performance measures affected by customer-supplier integration	
		S&OP process effectiveness	S&OP process efficiency
Logistical			
High complexity of demand side	<p><i>High</i></p> <ul style="list-style-type: none"> • Relational • Information sharing • Information technology 	<p><i>Forecast accuracy</i></p> <ul style="list-style-type: none"> • Demand forecast accuracy <p><i>Resource adherence</i></p> <ul style="list-style-type: none"> • Capacity capability • Inventory adherence • Inbound delivery reliability <p><i>Trade-offs measures</i></p> <ul style="list-style-type: none"> • Demand plan vs production plan; actual inventory vs inventory targets; inventory levels vs capacity levels <p><i>Plans adherence</i></p> <ul style="list-style-type: none"> • Supply and demand plan adherence; actual financial performance of plan vs business targets <p><i>Actual vs target performance</i></p> <ul style="list-style-type: none"> • ROI • Customer satisfaction 	<p><i>Process</i></p> <ul style="list-style-type: none"> • Supply and demand planning routines • Meeting efficiency • Resource efficiency committed to conduct S&OP
Distant channel position of key supplier from end-customer			
High requirements on supplier's flexibility			
High importance of suppliers			
High importance of customers			
Long lead time of raw materials/components			
Innovation			
High need for innovation of products	<p><i>High</i></p> <ul style="list-style-type: none"> • Relational • Information sharing • Information technology 	<p><i>Forecast accuracy</i></p> <ul style="list-style-type: none"> • Ramp up/ ramp down, and demand forecast accuracy <p><i>Resource adherence</i></p> <ul style="list-style-type: none"> • Capacity/ resource capability <p><i>Trade-offs measures</i></p> <ul style="list-style-type: none"> • Ramp up of products vs contribution margins; actual vs planned inventory; actual vs planned sales <p><i>Plans adherence</i></p> <ul style="list-style-type: none"> • Supply and demand plan adherence; actual financial performance of plan vs business targets <p><i>Actual vs target performance</i></p> <ul style="list-style-type: none"> • ROI • Customer satisfaction 	<p><i>Organization</i></p> <ul style="list-style-type: none"> • Communication of S&OP measures throughout organization and to key suppliers and customers • Monitoring of progress of plans • IT support to gather and analyze relevant performance measures <p><i>People</i></p> <ul style="list-style-type: none"> • Degree of cross-functional participation • Degree of executive participation • Degree of suppliers and customers participation • Competence/ skills
Technological/Socio-political			
High product quality requirements	<p><i>High</i></p> <ul style="list-style-type: none"> • Relational • Information sharing • Information technology 	<p><i>Resource adherence</i></p> <ul style="list-style-type: none"> • Capacity/ resource capability <p><i>Actual vs target performance</i></p> <ul style="list-style-type: none"> • ROI • Customer satisfaction 	
High requirements on certification/ validation of products/ processes			
High requirements on environmental sustainability of products/ processes			

(continued)

Contextual factors	Appropriate level of customer-supplier integration	S&OP performance measures affected by customer-supplier integration	
		S&OP process effectiveness	S&OP process efficiency
<i>Other</i>			
Low importance of suppliers	<i>Low</i> <ul style="list-style-type: none"> • Relational • Information sharing • Information technology 	Low impact on the S&OP process performance	
Low importance of customers			
Short lead time of raw materials/components			
Initial stage of relationship			

On the other hand, *low importance of suppliers, low importance of customers, short lead time of raw materials/components, and initial stage of relationship* can be appropriately managed by low levels of integration. The effect on the S&OP process performance is also limited.

The framework shows that different contextual factors can be related to different S&OP process effectiveness measures. The factors promoting high level of external integration were further clustered in three groups based on their conceptual similarities: *Logistical, Innovation, Technological/socio-political* group. These aspects are important to consider as they can affect effectiveness of the S&OP process in terms of forecast accuracy, resource adherence, trade-offs measures, plans adherence, and actual versus target performance.

Furthermore, the framework also includes measures of the process efficiency. Process efficiency measures strive to ensure that the S&OP process itself is well managed. Potentially, they can also influence the link between the SC partners and the S&OP process. In the framework, this aspect is reflected in Communication of S&OP measures throughout the organization and to key suppliers and customers. It is also reflected in the degree that key suppliers and customers participate at relevant S&OP meetings. This connects to Grimson and Pyke, (2007) who stress involvement of suppliers and customers in the process. They associate it with a rather high maturity level 4 of the process; however, this research has not found this activity at any of the studied cases.

6.2 Contributions and implications

In management studies, a theoretical contribution has been regarded as critical, referring to novelty or uniqueness. The theoretical contribution represents advancement in knowledge in the field and offers new connections between existing concepts (Locke and Golden-Biddle, 1997). Moreover, Corley and Gionia (2011) discuss that in management studies,

there is often an implication of these theoretical connections for problem-solving, referred to as practical implication.

6.2.1 Theoretical contributions

The main area to which this dissertation connects and contributes is integration literature – from a supply chain (external) as well as cross-functional (internal) perspective.

This research contributes to previous literature by confirming some existing challenges of Supply Chain Integration but also by identifying additional challenges. The findings extend the knowledge about factors that may hinder external integration (Zhao et al., 2013) and their effect on selection of specific integration activities (Danese, 2011).

Concerning the S&OP process, this thesis contributes to the fragmented literature on the S&OP process evaluation challenges (Tuomikangas and Kaipia, 2014; Thomé et al., 2012a; Grimson and Pyke, 2007; Bower, 2005) by synthesizing and extending the existing knowledge. To capture the importance of the process view for the S&OP process performance evaluation, the identified challenges were structured into a framework (see Figure 8) based on S&OP process effectiveness and efficiency (Neely, 1998). Additionally, the framework structures the challenges based on maturity levels (Grimson and Pyke, 2007). This research also adds to S&OP literature as it identifies challenges not only for the individual maturity levels but also those challenges common for several maturity levels.

This thesis further extends the previous context based external integration research (e.g. Christopher et al., 2006; van Donk and van der Vaart, 2005; Lee, 2000; Fisher, 1997; Kraljic, 1983) by proposing a framework for evaluation of external integration (see Figure 9). The proposed framework is founded on existing theory as well as the contextual factors that were considered by the studied cases when integrating with their customer and suppliers. Furthermore, the factors were observed to promote establishment of an appropriate level of external integration. Each level then consists of identified integration activities grouped into three clusters (i.e. Relational, Information sharing, and Information technology).

Several of the contextual factors were previously discussed in literature (e.g. Danese, 2011; van Donk and van der Vaart, 2005; Power, 2005; Fisher, 1997; Kraljic, 1983). However, additional factors were observed such as high requirements on certification/validation of products/processes, and high requirements on environmental sustainability of products/processes. Moreover, the study confirms previous external integration research in that the scope of the research is

limited to dyadic relationships (Näslund and Hulthen, 2012; Jayaram et al., 2010; Fabbe-Costes and Jahre, 2008).

The thesis extends the S&OP performance research by addressing the lack of process oriented frameworks for evaluation of the process performance (e.g. Thomé et al., 2012; Grimson and Pyke, 2007). The proposed framework of measuring the S&OP process performance (Figure 10) considers the five major steps of the process and their outputs as well as the output of the whole process. To reflect the process performance measures, the framework structures and defines effectiveness and efficiency measures and their relation to the process performance. The proposed framework adds to the existing more generic S&OP performance frameworks such as the SCOR model framework (by Thomé et al., 2012a) and the S&OP scorecard (by Milliken, 2008). The framework also complies with the multiple criteria for development of appropriate performance measures, as suggested by Caplice and Sheffi (1995).

Finally, by synthesizing the results of the thesis, a framework of external integration and its effect on the S&OP process performance was proposed (see Table 25). This framework is based on the observed contextual factors and corresponding levels of external integration. The aim is to increase the understanding of organizational context and its effect on external integration as advocated by several authors (e.g. Fawcett et al., 2015; Wong et al., 2015; van der Vaart et al., 2012). Then, the level of integration is linked with the relevant S&OP performance measures. The framework aims to increase insight about the importance of including customers and suppliers into the S&OP process (Grimson and Pyke, 2007) and extending the process beyond organizational boundaries to improve individual firm performance and also supply chain performance.

6.2.2 Practical implications

The main findings of the research and the proposed frameworks can assist practitioners in evaluating external integration and the S&OP process.

The framework for evaluation of external integration (see Figure 9) can help companies to manage their level of integration (i.e. intensity of integration) with suppliers and customers in agreement with the principle that “not all relationships are created equal” (Fawcett et al., 2015). The framework proposes a set of contextual factors that are related to a high level of external integration in terms of relational, information sharing, and information technology aspects. It also identified contextual factors that are related to a low level of external integration. It is argued that by appropriately matching the contextual factors with level of external integration, organizational resources invested in building external

integration can be used more efficiently (e.g. van der Vaart et al., 2012; Donaldson, 2001).

To illustrate, the suggested level of an appropriate external integration is high (i.e. long-term relationships and contracts, regular quality audits, planning and business review meetings) considering the contextual factor of high product quality requirements. On the other hand, the proposed level of an appropriate external integration is low (i.e. limited quality audits and business review meetings, standardized information sharing) with the contextual factor of short lead time of raw materials/components.

Additionally, the proposed framework in Figure 7 can support managers in identifying contextual factors that might challenge establishment of an appropriate level of external integration. These situations might require increased attention. For example, an appropriate level of external integration to manage a contextual factor such as high need of innovation of products would be high (e.g. cross-firm planning and innovation meetings including direct contact between supplier's and customer's sales/marketing functions). However, the studied cases apply a low level of integration. On the other hand, the contextual factor of initial stage of relationship would be appropriately managed by applying a lower level of integration including, for example, traditional order handling instead of currently used VMI consignment stock.

The framework for evaluation of the S&OP process performance (see Figure 10) can offer assistance for managers when designing measures to improve effectiveness and efficiency of their S&OP process. The framework can also support standardization of measures in order to enhance organizational transparency. Additionally, it can improve analysis of the process performance, which might initiate potential organizational changes and support enhanced process orientation. Consequently, increased corporate effectiveness and efficiency can ideally be achieved.

Moreover, as the framework is founded on measures for the individual steps of the S&OP process, their performance might be evaluated, analyzed and improved, which consequently might lead to improvement of the whole process performance.

6.3 Future research opportunities

The results of this thesis provide several opportunities for future research. Below, areas for future research on evaluation of external integration are discussed, followed by areas on evaluation of S&OP process performance. Finally, future research on the intersection between these two areas is suggested.

- Studies investigating contextual factors that challenge establishment of an appropriate level of external integration.

The findings of this research identified a set of contextual factors that were observed to challenge an appropriate level of external integration with customers. Considering that many organizations still find it difficult to manage integration with their partners (e.g. Fawcett et al., 2015; Cook et al., 2011; van Donk and van der Vaart, 2005) it is desirable to direct future studies to investigating the contextual factors that challenge external integration. More research is needed to validate the factors identified in this research and to identify additional factors.

- Studies on supplier and customer perception of supplier-customer integration levels.

Additionally, the findings also indicate that an inappropriate level of external integration was perceived predominantly by the suppliers. Insufficient level of integration with customers, considering the context, was also reported when the supplier and customer were highly interdependent. This partly corresponds to findings by Caniëls and Gelderman (2007) who question the existence of highly interdependent relationships. However, they conclude that these relationships are often characterized by supplier dominance. To increase understanding of how customers and suppliers perceive their level of external integration in relation to their context can represent another future research opportunity.

- Studies exploring drivers and barriers of external integration, as well as its evaluation, in the context of application of new technologies.

In this thesis, external integration was studied in the manufacturing industry. It was concluded that the scope of integration can be best described as dyadic. However, the rapid growth of digital, social and mobile technologies and their increasing adaptation affect the way end-customers purchase products and services. Thus, it would be interesting to investigate the drivers and barriers of external integration and how it can be evaluated in industries (e.g. retailing) that are affected by this trend.

- Studies to validate the identified challenges of evaluating the S&OP process performance including the whole spectrum of maturity levels.

Related to challenges of evaluating the S&OP process performance, future studies could validate the results of this thesis through additional cases representing all different levels of the S&OP process maturity (including companies on the highest level). The results could also be validated and extended in, for example, the service industry.

- Studies addressing the challenges of evaluating the S&OP process performance common for several maturity levels of the process.

Future research can increase understanding of the challenges observed across several maturity levels such as defining cross-functional trade-offs and their alignment with overall business strategy and reward systems (Tuomikangas and Kaipia, 2014; Thomé et al., 2012a), visualization of measures, and evaluation of various planning scenarios. Future studies may develop guidelines for managers on how to define the trade-offs measures and how to align them with strategy and reward systems. Another aspect to study is how to apply IT and Business Intelligence software to enhance analysis and visualization of S&OP measures (e.g. informative dashboards customized for different users) and evaluation of various planning scenarios.

- Studies addressing the challenges of evaluation of the S&OP process performance associated with more advanced maturity levels of the process.

The findings show that the studied cases at higher maturity levels (levels 3 and 4) experience difficulties to standardize the S&OP measures across their organizations and to customize them for various levels and groups. Thus, future research may focus on examining the issues through, for example, in-depth multiple case studies.

- Studies on validating the framework for measuring performance of the S&OP process in other industries, and through action research.

The proposed framework is based on five cases from the manufacturing industry. It is necessary to validate the framework through additional cases. Furthermore, it is suggested to investigate, for example, how the framework can be adapted for the service industry. Additionally, the framework can be tested by applying action research to study how its implementation supports decisions, and whether it leads to observable performance improvements. It would also be beneficial to investigate the challenges associated with the implementation of the framework.

- Studies on adjustment of S&OP measures to changes in organizational context and level of external integration.

It can be investigated how the S&OP measures can be adapted to reflect changes in contextual factors and consequently in levels of external integration. The changes in contextual factors include, for example, various supply chain strategies for different types of products, stages in relationships with SC partners, complexity of the demand side and requirements on supply flexibility, lead times, need for innovations, and

quality requirements. Further, potential evaluation challenges can also be explored.

- Studies on how to integrate customers and suppliers into the evaluation of S&OP process performance.

The previous S&OP literature suggests that key suppliers and customers should be involved in some S&OP meetings (Grimson and Pyke, 2007). The proposed final framework (see Table 25) in this dissertation also stresses the importance of communicating S&OP measures to key suppliers and customers. However, the data show that none of the studied cases communicated measures to customers or suppliers. Thus, future research can investigate how to integrate vital SC partners in the S&OP process and identify which measures are beneficial to share considering context and potential performance benefits of doing so.

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Appendix 1

Study 2 – Grounded theory approach

Letter of introduction, project description, and interview guide

LETTER OF INTRODUCTION

Hej,

mitt namn är Hana Hulthén och jag är doktorand på avdelningen för Teknisk logistik vid Lunds Tekniska Högskola.

Mitt forskningsområde är integration i försörjningskedjor (Supply Chain Integration). Jag arbetar med att utveckla konkreta riktlinjer och normativa rekommendationer för företags externa integration. Specifikt undersöker jag hur företagets kontext påverkar affärsrelationer och omfattning av integration i försörjningskedjan.

I dagsläget saknas det samlad kunskap kring ämnet och det som finns är ofta fragmenterad. Dessutom påstås det ofta att ”ju mer integration desto bättre prestanda.” och en universal lösning som ska gälla alla är det som oftast föreslås i teorin.

I dessa rekommendationer tas ofta inte hänsyn till att företagen är påverkade av flertalet externa och interna faktorer (t.ex. typ av företag, produkt, konkurrensnivån i industri m.m.) och att dessa spelar roll när det gäller typ och nivå av integration. I bilagan till detta brev bifogar jag vår projektbeskrivning.

Jag vore mycket tacksam om jag skulle kunna ta del av dina erfarenheter och tankar kring detta område. Jag planerar att genomföra ett flertal intervjuer med relevanta respondenter från industri.

Skulle vi kunna boka tid för ca en timmes intervju? Du kan bestämma tiden som bäst passar för dig.

Med vänliga hälsningar

Hana Hulthén

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PROJECT DESCRIPTION

Type of work: Licentiate thesis

Subject area: Supply Chain Integration (SC Integration)

The overall purpose: to enhance the knowledge regarding organizational context and its effect on Supply Chain Integration.

Research objective: to develop a model of contextual factors and Supply Chain Integration that can provide support for practitioners regarding what level of integration to establish with suppliers and customers.

Research questions:

- **RQ1:** What are the contextual factors related to Supply Chain Integration and how they can be structured?
- **RQ2:** What is the relationship between contextual factors and level of Supply Chain Integration?

Respondents/data collection: Open ended interviews with supply chain managers, Logistics Managers, purchasers, sales managers and manufacturing managers from industry with experience and knowledge of the subject area.

Background to the project and problem discussion

Companies experience many challenges including turbulent economic environment, demanding customers, increased complexity of products, and advancement in information and communication technology, among others. These factors contribute to a higher degree of outsourcing, vertical disintegration and increased globalization which intensified dependency on inter-organizational relations.

Inter-organizational relationships require management and coordination to become an effective tool in today's competitive environment as organizations are forced to rely on number of external suppliers to deliver value to customers. Thus, management and coordination of activities intra-organizationally within a single firm, as well as inter-organizationally among organizations, known as Supply Chain Integration is considered to be important.

In literature, it is commonly stated that SC Integration leads to lower costs, higher quality and enhanced service level, to name but a few positive outcomes. Common assumption seems to be that the more integration, the better performance.

However, SC Integration is more "*rhetoric than reality*" in most industries and seamless integration of products, services and information flows from source of raw material to end customer is difficult to achieve in practice. Majority of

companies experience difficulties to implement SC Integration. Therefore, questions have been raised regarding the nature of SC Integration and the extent to which it can be accomplished. Instead of all-encompassing integration, selectivity in terms of what type and level of integration should be applied to each supply chain link has been suggested.

Practical implications of this study

As managers face various internal and external factors associated with, for example, the company, industry, competitive environment, and nature and type of products, the importance of organizational *context* needs to be taken into consideration when assigning a preferable degree and scope of SC Integration. This knowledge may prevent practitioners from developing integrative relationships if the gains are only marginal.

Previous research does not provide clear recommendations for practitioners in this question and the existing knowledge is often very fragmented. Therefore, a unifying framework of SC Integration that would offer a systematic approach with specific guidelines on *who*, *how* and *when* to integrate should be developed to support practitioners through the integrative process.

INTERVIEW GUIDE

The interview (approx. one hour) will be guided by the following broad questions in order to cover the main aspects of the subject of this study.

Background

Name:

Company:

Job title

Years with company:

Previous experience:

Interview questions

- 1) How would you describe the current situation regarding integration with your suppliers/ customers? (i.e. How do you collaborate with your suppliers/ customers on operational, tactical and strategic organizational level?)
- 2) What are the factors that influence how much or little do you collaborate with your suppliers/ customers? (i.e. Why do you collaborate with some suppliers/customers more than with others?)
- 3) How could be improved the current situation concerning the integration with your suppliers/ customers?
- 4) Can you please mention one example of successful integration with your suppliers/ customers suppliers?

Appendix 2

Study 3 – Multiple case study approach

Case study protocol

Background information

Name:

Company:

Division:

Industry:

Type of products:

Organization/ Supply chain strategy:

Job Title:

Years in Position/ with company:

The S&OP process

Please describe your S&OP process:

- 11) What is the main objective/goal of the process in your organization?
- 12) How long have you been working with the process?
- 13) What are the main steps of the process and how often are they conducted?
- 14) What is the planning horizon?
- 15) Is the process owner established? His/her position within your company?
- 16) Who participates in the process?
- 17) Are their responsibilities clearly specified in a job description?
- 18) How do you involve finance and budget in the S&OP process?
- 19) How do you distribute the final plans throughout your organization?
- 20) How are planning modules and tools linked via interfaces to information systems?
- 21) What is the maturity level (1-5) of your S&OP process?

Stage 1 No S&OP process	Stage 2 Reactive	Stage 3 Standard	Stage 4 Advanced	Stage 5 Proactive
<ul style="list-style-type: none"> • No formal planning • Operations attempts to meet incoming orders 	<p><i>Goal:</i> development of an operational plan</p> <ul style="list-style-type: none"> • Sales plan drives operations • Top-down process • Capacity utilization dynamics ignored 	<p><i>Goal:</i> demand and supply matching</p> <ul style="list-style-type: none"> • Some plan integration • Sequential process in one direction only • Bottom up plans – tempered by business goals 	<p><i>Goal:</i> Profitability</p> <ul style="list-style-type: none"> • Plans highly integrated • Concurrent and collaborative process • Constraints applied in both directions 	<p><i>Goal:</i> demand sensing, and conscious trade-offs for demand shaping to drive an optimized demand response</p> <ul style="list-style-type: none"> • Seamless integration of plans • Process focus on profit optimization for whole company

Source: Grimson and Pyke (2007); Cecere et al., (2009)

Performance measures and measurement challenges of the S&OP process

1) When measuring the S&OP process do you distinguished between measures for effectiveness and efficiency? *S&OP Process Effectiveness* refers to measures of how satisfactory is the S&OP plan, while *S&OP Process Efficiency* relates to measures of how well is the S&OP process managed.

Examples of measures related to S&OP process effectiveness and efficiency

Performance measures related to S&OP process effectiveness	Performance measures related to S&OP process efficiency
<p>Customer satisfaction/ retention</p> <ul style="list-style-type: none"> • Warranty/ return processing cost • Customer complaints/rate of complaints • Customer response time • Flexibility of service systems to meet particular customer needs • etc. <p>Value creation</p> <ul style="list-style-type: none"> • Order fill rate • Number of on-time deliveries • Delivery lead time • Delivery reliability/ accuracy • etc. <p>Profit optimization</p> <p><u>End Results</u></p> <ul style="list-style-type: none"> • Perfect orders, revenue, profitability, inventory • Return on assets • Cash-flow • Return on investments • etc. <p><u>Trade-offs</u></p> <ul style="list-style-type: none"> • Actual vs. planned profitability • Actual vs. planned revenues • Actual vs planned customer service • Actual quantities shipped vs. quantities ordered • Meet demand with reduced inventory • etc. 	<p>Operational improvements</p> <ul style="list-style-type: none"> • Forecast accuracy • Variation in customer demand • Number of new products launched • etc. <p><u>Reduce inventory/stock-outs level</u></p> <ul style="list-style-type: none"> • Inventory turnover ratio • Inventory costs • Number of stock-outs • etc. <p><u>Optimize supply capacity</u></p> <ul style="list-style-type: none"> • Lead time with suppliers • Materials quality • Supplier fill rate • etc. <p><u>Balance capacity resources/ allocate critical resources</u></p> <ul style="list-style-type: none"> • Production capacity utilization • Production costs • Cost per operation hour • etc. <p><u>Balance volume/ mix</u></p> <ul style="list-style-type: none"> • Mix flexibility • Volume flexibility • Product flexibility <p><u>Aid new product introductions</u></p> <ul style="list-style-type: none"> • Product development cycle time • etc. <p><u>Manage constraints, uncertainties and risk</u></p> <ul style="list-style-type: none"> • Production capacity shortage • % of excess/ lack of resource within a period • etc.

Currently used performance measures/ KPI's of the S&OP process and their level of criticality

1a) What measures/ KPI's you currently use to monitor *the S&OP process effectiveness*? How critical do you consider them to be and why? What are the *challenges* you experience to measure the effectiveness?

Currently used performance measures related to the S&OP process effectiveness	KPI?		Do you agree that monitoring this measure/ KPI is critical					Why?
	Yes	No	1 Strongly disagree	2 Disagree	3 Neither agree or disagree	4 Agree	5 Strongly agree	

1b) What measures/ KPI's you currently use to monitor *the S&OP process efficiency*? How critical do you consider them to be and why? What are the *challenges* you experience to measure the efficiency?

Currently used performance measures related to the process effectiveness	KPI?		Do you agree that monitoring this measure/ KPI is critical					Why?
	Yes	No	1 Strongly disagree	2 Disagree	3 Neither agree or disagree	4 Agree	5 Strongly agree	

2) Please, indicate if the following statements correspond to your current situation. Indicate *challenges* you experience with measuring the efficiency of the process.

Performance Measures related to the S&OP Process Efficiency							
Goals	Statements	Do the statements correspond to the current situation?					
		1 Strongly disagree	2 Disagree	3 Neither agree or disagree	4 Agree	5 Strongly agree	How?/ Why?
Alignment and integration	Cross-functional alignment of plans/ Integration capabilities						
	<ul style="list-style-type: none"> All function are represented in the S&OP process 						
	<ul style="list-style-type: none"> Compelling events are monitored (e.g. major product shortage, competitive market threats) 						
	<ul style="list-style-type: none"> Ability to respond to unplanned events in a timely manner is monitored 						
	<ul style="list-style-type: none"> Gaps between financial plans and S&OP plans are monitored and corrective actions taken 						
	Supply Demand Planning in balance						
	<ul style="list-style-type: none"> Constrained planning scenarios are evaluated during supply and demand balancing 						
	Response management						
	<ul style="list-style-type: none"> Inventory levels are monitored within established tolerance 						
	Forward looking view						
	<ul style="list-style-type: none"> Sales forecast, production and inventory for each SKU/ product family are monitored 						

	Planning linked to execution						
	<i>Visibility</i>						
	<ul style="list-style-type: none"> The S&OP metrics is regularly communicated across organization (How often/ who receives the information?) 						
	<i>Monthly planning tied to weekly operating reviews</i>						
	<ul style="list-style-type: none"> Cross-functional team monitors progress and guide the organization through plan execution with weekly focused operational reviews 						
	<i>Sensing and eliminate waste</i>						
	<ul style="list-style-type: none"> Slow and obsolete inventory (SLOB) is quickly identified and plans are formulated in the S&OP process 						
	Measure and communicate the plan						
	<ul style="list-style-type: none"> High-level reporting (KPI's tools) is designed for executive management 						
	<ul style="list-style-type: none"> Daily performance against S&OP metrics is monitored to be proactively alerted when deviation occurs 						

Performance Measures related to the S&OP Process Efficiency							
Goals	Statements	Do the statements correspond to the current situation?					
Alignment and integration	Knowledge	1 Strongly disagree	2 Disagree	3 Neither agree or disagree	4 Agree	5 Strongly agree	How?/ Why?
	<ul style="list-style-type: none"> The S&OP team comprises of people that can make decision 						
	<ul style="list-style-type: none"> The team possess sufficient knowledge to perform the S&OP process 						
	<ul style="list-style-type: none"> Process owner is established 						
	<ul style="list-style-type: none"> S&OP responsibilities clearly defined in a job description 						
	Meeting efficiency						
<ul style="list-style-type: none"> Attendance of all S&OP team members is monitored at each S&OP meeting 							
<ul style="list-style-type: none"> The frequency of the review meeting/s is monitored 							
<ul style="list-style-type: none"> Pre-meeting work done on time is monitored 							
<ul style="list-style-type: none"> Re-planning frequency is monitored 							

	Information preparation and sharing						
	Information availability						
	<ul style="list-style-type: none"> Availability of crucial KPI's (financial and non-financial) and all planning data is monitored 						
	Information redundancies						
	Information Technology						
	Performance metrics dissemination <ul style="list-style-type: none"> Support IT system is utilized to gather relevant performance measures and communicate them throughout organization 						
	Cross-functional integration, integration with strategy and reward system						
	<ul style="list-style-type: none"> Current PMS is aligned cross-functionally (How?) 						
	<ul style="list-style-type: none"> Current PMS is aligned with business strategy (How?) 						
	<ul style="list-style-type: none"> Current PMS is aligned with reward system (How?) 						

Performance measures/ KPI's critical to be introduced into the current S&OP measures or to be removed

3) What S&OP related performance measures/ KPI's do you consider to be highly critical to introduce (add) or remove from the current metrics? Why? What should be improved in measuring the process?

Performance measures critical to be introduced	Why?	Current performance measures to be removed	Why?

Additional questions

Performance measurement system/ KPI's

4) How often are measurements taken?

5) How is the feedback on performance of the S&OP process used for?

Roles and responsibilities

6) What is the roll of each member the S&OP team in terms of monitoring the performance against the S&OP metrics/performance measurement system (PMS)?

Maturity level of the S&OP process measurements

7) What is your maturity level (1-5) of measurements of the S&OP process?

Stage 1 No S&OP process	Stage 2 Reactive	Stage 3 Standard	Stage 4 Advanced	Stage 5 Proactive
<ul style="list-style-type: none"> No measurements 	<ul style="list-style-type: none"> Measure how well Operations meets the sales plan Order fill rate, asset utilization, inventory levels 	<ul style="list-style-type: none"> Stage 2 plus: Sales measured on forecast accuracy Order fill rate, forecast error, inventory turns, functional costs 	<ul style="list-style-type: none"> Stage 3 plus: New Product Introduction S&OP effectiveness Demand errors, customer service, working capital, total costs 	<ul style="list-style-type: none"> Stage 4 plus: Company profitability Demand risk, customer service, cash flow, market share, and profit

Source: Grimson and Pyke (2007); Cecere et al., (2009)

Additional challenges of measuring the S&OP process performance

8) Please describe additional challenges you experience when measuring performance of the process.

9) Why do you experience these challenges?

10) How do you handle these challenges?

Appendix 3

Appended papers

- P1: Näslund, D., and Hulthen, H. (2012). "Supply chain management integration: a critical analysis." *Benchmarking: An International Journal* Vol. 19, No 4/5, pp. 481-501. (Highly Commended Paper Award 2013 in Emerald Literari Network)
- P2: Hulthén, H. "A Grounded Theory based study of contextual factors and their effect on external integration in supply chains." (Under review in *International Journal of Logistics Management*)
- P3: Hulthén, H. and Pazirandeh, A. "Reasons for limited integration in highly interdependent buyer-supplier relationships: Insights from two cases." (Under review in *Journal of Purchasing and Supply Management*)
- P4: Hulthén, H., Naslund, D., and Norrman, A. "Challenges of Measuring the Sales and Operations Planning Process." (Accepted for publication in *Operations and Supply Chain Management: An International Journal*)
- P5: Hulthén, H., Naslund, D., and Norrman, A. (2016). "Framework for Measuring the Performance of the Sales and Operations Planning Process: A Multiple-case Study". *International Journal of Physical Distribution & Logistics Management*, forthcoming Vol. 46, No. 9, pp. 1-28.