UNIVERSITÀ DEGLI STUDI DI UDINE

DIPARTIMENTO POLITECNICO DI INGEGNERIA E ARCHITETTURA

DOTTORATO DI RICERCA IN
INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE

XXXII ciclo

PH.D. THESIS

CONTEXTS AND MECHANISMS TO DEVELOP SUPPLY CHAIN INTEGRATION AND IMPROVE PERFORMANCE: A MULTI-METHOD INVESTIGATION

CANDIDATE
Margherita Molinaro

SUPERVISOR
Prof. Pietro Romano

CO-SUPERVISOR
Prof.ssa Pamela Danese

2020

ABSTRACT

Supply Chain Integration (SCI) is a management practice that aims at creating “seamless” supply chains through the sharing of information, skills and resources among supply chain partners. If properly implemented, SCI plays an important role for the competitiveness of companies and, for this reason, it has been widely studied by scholars. However, despite the extensive literature, several research gaps, regarding both its proper and effective implementation and its relationship with performance, exist.

In response to the mentioned gaps, this PhD research has the following three main goals:

1. To investigate the role of context in shaping the relationship between supply chain integration and performance;
2. To understand how to properly implement supply chain integration;
3. To identify and empirically investigate contingent factors that interact with supply chain integration to provide the maximum performance benefits to companies.

The thesis is a collection of three scientific papers, each of which addresses one of these three main goals.

The first paper realizes a Systematic Literature Review on the fit between context, SCI practices and performance. The aim is not only to provide a comprehensive overview of the state-of-the-art of research to better understand the influence of context on the SCI-performance link, but also to identify “white spaces” for future research opportunities.

The second paper focuses instead on a particular form of SCI, the Sales and Operations Planning (S&OP) process, and studies how to execute transitions between different maturity levels. Three case studies of S&OP transitions are analyzed and compared in order to develop an understanding of common patterns and differences in the dynamics occurred.

Finally, the last paper, a survey-based research, tests the contingent effect of supply base reduction on the relationship between four different dimensions of upstream integration and two performance measures, efficiency and innovation. Using data of the High Performance Manufacturing project, the paper provides suggestions on how to combine supply base reduction and supplier integration in order to maximize performance.

Overall, this thesis provides several contributions for both theory and practice. On the one hand, it offers a detailed and original overview of the SCI literature and extends our knowledge on the topic of SCI. On the other, it also provides indications to managers on how to implement SCI, identifying potential mistakes and drawbacks that could easily hinder the effective implementation of SCI or the achievement of its expected benefits.

ACKNOWLEDGEMENTS

First and foremost, my gratitude goes to my two PhD supervisors, Prof. Pietro Romano and Prof.ssa Pamela Danese, for their continuous support during these three years, for the knowledge they shared with me and for all the time and energy they invested in helping and guiding me in my PhD program.

I would also like to acknowledge Prof. Morgan Swink, who hosted me at the Texas Christian University and was always available and happy to provide helpful feedbacks and suggestions for my research. It was an honour to work with him.

An important thank goes then to my friend Jasmine and all my past and actual collegues at the Universities of Udine and Padova: Alberto, Alonso, Andrea, Anna, Cinzia, Elena, Elisabetta, Giovanna, Li, Lorenzo, Lucia, Nadia, Matteo, Mauro, Riccardo, Valeria and Verdiana. We shared many positive and negative moments of our lives, making instructive and enjoyable the time spent together.

I thank also Novalia's team, not only for the knowledge we shared, but also for the friendship we developed. Many thanks to Giulia, Marco (Melo), Marco (Boem) and, above all, to Marco (Batti) and Fabio Candussio. I hope that our collaboration will continue over the years.

Finally, I want to make the biggest, and probably most heartfelt, thank my family. I cannot express how grateful I am to my mother, my father and my sister for their love, care and support in all the decisions I take throughout of my life. They will always represent a reference point for me. Obviously, I could never forget to mention Andrea, who, together with my family, deserves a special acknowledge at the end of these last three years. I sincerely thank him not only for his unconditional support, patience and understanding, but also for sharing with me every positive and negative moment of my life and career.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Chapter 1
INTRODUCTION

The current competitive system is characterized by a number of challenges, that go from an increasing level of globalization, complexity and market saturation to a quick development of information technologies for the design, production and delivery of products (Chaudhuri et al., 2018; Tang and Veelenturf, 2019). In this context, companies are constantly looking for solutions that allow them to exceed the competition, but this is not an easy task. While in the past the differentiation strategy, seen as a means to create value for the customer and to be successful in the market, could be based on the creation of customized, innovative and highly technological products (Porter, 1998), today things have changed. Value must no longer be sought in the product itself, but in the relationships created by the firm with its external partners. In simple words: supply chain integration (SCI).

SCI can be defined as “the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organization processes” (Flynn et al., 2010, p. 59). From this definition, it is clear that SCI can manifest in terms of internal integration of processes and business functions as well as external integration with customers and suppliers (Ataseven and Nair, 2017). The goal is to integrate material, financial and information flows among all the members of the network, thus creating “seamless” supply chains (Danese et al., 2013). In today complex environments, companies must therefore leverage on SCI to create a strong network of relationships, based on sharing and exchanging company skills and resources, with the aim of creating value for all supply chain partners (Chaudhuri et al., 2018).

The concept of SCI, also named with the terms supply chain collaboration or cooperation, is not new and the idea that competition no longer takes place among the isolated entities in the system, but among different supply chains in the market was developed several years ago (Kamal and Irani, 2014). However, in the actual context characterized by increasingly complex and digitally driven supply chains, SCI becomes even more important to be competitive on the market. The topical relevance of this theme and the importance to further develop it are evident in both theory and practice.

On the one hand, the attention of the scientific community on the topic, and in particular on the relationship between SCI and performance, has not decreased, as several recent publications attest (e.g. Shou et al., 2018; Delic et al., 2019). The focus is now moved on the role of context in determining the achievement of the expected benefits of integration. Several authors have indeed identified different contextual factors that may influence the positive effects of SCI, testing different modes through which they may affect the relationship between SCI and performance. However, these works are fragmented, as they significantly differ in terms of contingencies and research frameworks, as well as in results, and a comprehensive overview of the topic is still lacking.

On the other hand, despite the extensive literature, the implementation of effective collaboration practices is still a challenge for many companies (Huo et al., 2016). The causes of this situation can be at least two: (1) lack of appropriate guidelines that results into mistakes in the implementation and/or development phases; (2) implementation of SCI in inappropriate contexts, following the general and wrong idea that SCI is always beneficial. The former cause is particularly evident in one of the most important forms of SCI, the Sales and Operations Planning (S&OP), which consists into a process aimed at unifying different business plans into one integrated set of plans (Thomé et al., 2012). As underlined by Pedroso et al. (2016), the implementation of S&OP is difficult and challenging and the literature lacks detailed guidance to support managers in this activity. The second cause is instead related to a lack of proper understanding of the link between context, SCI practices and performance. Extending the existing literature and identifying additional contextual variables and/or managerial practices that allow to reach the maximum levels of performance becomes thus fundamental for both managers and academics.

Given the considerations just described, this PhD research has the following main goals:

1. To investigate the role of context in shaping the relationship between supply chain integration and performance;
2. To understand how to properly implement supply chain integration;
3. To identify and empirically investigate contingent factors that interact with supply chain integration to provide the maximum performance benefits to companies.

This thesis is a collection of three papers, which address the three mentioned goals. Despite its structure, the thesis should not be seen as the presentation of three independent works of the author, but as the sequential development of the huge topic of SCI.

The rest of the thesis is structured as follows.

Chapter 2 provides a theoretical background on supply chain integration that includes a description of its definitions and dimensions, a focus on its relationship with performance and an overview of Sales and Operations Planning. This short theoretical summary does not aim to be exhaustive, but just suitable for the purpose of providing a general overview on SCI. The reader can directly refer to the papers (Chapter 4, 5 and 6) for an in-depth analysis of the relevant literature.

Chapter 3 describes the development of the PhD research and the related logical phases, which resulted into the realization of the three papers included in this thesis. A short description of these papers is provided, together with an explanation of the papers' motivations, methodology and results.

Chapter 4 presents the first paper, a systematic literature review on the role of context in shaping the relationship between SCI and performance, which addresses the first goal of the PhD research. The results of the paper, which consist in both a description of past research findings and the identification of future research directions, provide the motivations for the following two papers. Chapter 5 includes the second paper, a case study, which aims at achieving the second goal of the PhD research and is adapted from "*Managing evolutionary paths in Sales and Operations Planning: key dimensions and sequences of implementation*"[1]. The paper is focused on one of the most important forms of internal integration, the Sales and Operations Planning, and aims at providing a tool that helps to understand how to properly implement S&OP in order to reach more advanced maturity levels.

Chapter 6 presents the third paper, a survey-based research, which is focused on the integration with upstream partners and addresses the third goal of the PhD research. In particular, it investigates whether interactions between supplier integration dimensions and supply base reduction impact efficiency and innovation, with the aim to provide suggestions on how to combine these two managerial decisions to maximize performance.

Finally, Chapter 7 provides some general conclusions of the overall PhD research, highlighting its contributions for theory and practice and acknowledging its main limitations.

[1] Danese, P., Molinaro, M., and Romano, P. 2018., Managing evolutionary paths in Sales and Operations Planning: key dimensions and sequences of implementation. *International Journal of Production Research* 56(5), 2036-2053. Paper reprinted with permission.

Chapter 2
THEORETICAL BACKGROUND

Supply chain integration is a widely investigated topic in the supply chain management literature. According to Flynn et al. (2010, p. 59), SCI can be defined as the "degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organization processes". The aim is to go beyond a single firm's boundaries in order to coordinate business processes seamlessly (van der Vaart and van Donk, 2008), as well as to develop effective and efficient flows of products, services and information (Frohlich and Westbrook, 2001).

As underlined by many authors (e.g. Fabbe-Costes and Jahre, 2008; Ataseven and Nair, 2017), the literature offers numerous definitions, measurements and operationalizations of SCI. Indeed, while some studies adopt unidimensional constructs of integration, others focus on specific dimensions of SCI. A typical classification is based on the direction of integration and distinguishes between internal, supplier and customer integration. Internal integration can be defined as the degree to which a manufacturer synchronizes its internal activities and implements internal practices and processes in a collaborative way (Flynn et al., 2010). A meaningful example of internal integration is the Sales and Operations Planning process, which requires strong communication and collaboration between the different business functions for the development of the company's planning processes (see Section 2.2). Supplier and customer integration, which are often merged into a single construct named external integration, refer instead to the cooperation and information sharing activities implemented with upstream and downstream partners respectively (Schoenherr and Swink, 2012). Apart from the direction of integration, the constructs of SCI developed in the literature can be distinguished also by the type of integration. Indeed, while some authors focus only on information sharing (e.g. Prajogo and Olhager, 2012) or technological integration (e.g. Sanders, 2007), others consider the cooperation in planning processes' implementation (e.g. Sanders, 2008), the collaboration in new product development (e.g. Koufteros et al., 2005), or a combination of two or more of these collaborative forms (e.g. Vickery et al., 2003). Several authors tried to categorize these measures of SCI, providing different classifications. For instance, Fabbe-Costes and Jahre (2008) distinguish between integration of flows (physical, information, financial), integration of processes and activities, integration of technologies and system and integration of actors (structure and organization). Van der Vaart and van Donk (2008) propose instead the categorization of SCI into practices, patterns and attitudes. Practices are tangible activities or tools that allow the focal firm to collaborate with its supply chain partners (e.g. Electronic Data Interchange), patterns refer to interactions between the firm and its partners (e.g. face-to-face communication), while attitudes denote the mindset of the supply chain partners (i.e. collaborative attitude). Finally, Leuschner et al. (2013) classify SCI as information, operational and relational integration, where information integration refers to communication, information sharing and the related supporting technology, operational integration represents the joint implementation of processes and activities and relational integration refers to the strategic nature of SCI.

2.1 SCI and performance: some theoretical lenses

One of the most investigated topics in the supply chain integration literature is the relationship between the different forms of SCI and performance.

For a long time, researchers have emphasized the benefits of SCI, showing that higher levels of integration have a positive effect on different performance dimensions (e.g., Frohlich and Westbrook, 2001; Danese and Bortolotti, 2014). Several theoretical lenses, which are described and summarized in Table 2.1, have been used by scholars to support these studies. The most common theory used to interpret and explain the SCI success is the resource-based view (RBV), according to which firms can be viewed as a collection of valuable resources that are difficult to imitate and, for this reason, can provide a sustained competitive advantage (Wernerfelt, 1984; Barney, 1991). The resources and capabilities generated through partnerships, information sharing and joint problem solving may be less exposed to imitation and, for this reason, SCI can contribute to the competitive advantage of the firm (Danese et al., 2013; Alfalla-Luque et al., 2015). A common extension of the RBV is the relational view (RV) of the firm, which suggests that close relationships with supply chain partners allow companies to acquire valuable resources they lack in-house and that could not be captured in isolation (Dyer & Singh, 1998). Therefore, thanks to the deep knowledge exchange, the specialized assets and the complementarities developed though the collaboration with supply chain partners, SCI can lead to higher performance outcomes (Leuschner et al. 2013; Wiengarten et al., 2016). The organizational information processing theory (OIPT) claims instead that an organization must develop its information processing capabilities in line with its information needs in order to be competitive in the market (Lawrence and Lorsch, 1967; Thompson, 1967). Applying this theory to SCI, the general idea is that information processing capabilities may be enhanced by coordinating activities, sharing information or developing appropriate IT platforms with supply chain partners. This is the reason why SCI is beneficial, especially in certain environments (e.g. the complex ones), where information processing capabilities are particularly critical and can be used to reduce uncertainty (Williams et al., 2013). Another widespread theory is the transaction cost economics (TCE), discussed by Coase (1937) and Williamson (1975). According to this view, the choice between vertical integration and external market depends on the costs arising not only from the transactions themselves, but also from the potential opportunism of supply chain partners. SCI, which can be positioned in between these two opposite strategies, represents a valuable alterative for companies, since it can help firms to reduce uncertainties and opportunistic behaviors, increase coordination, cut transaction costs and develop trust between the partners, resulting into an overall performance improvement (Das et al., 2006; Cao and Zhang, 2011).

Table 2.1 Main supporting theories in SCI research

Theory	Application in SCI research	Examples of application
Resource-based view - RBV (Wernerfelt, 1984; Barney, 1991)	The capabilities acquired from the partners through SCI and integrated into the internal processes are difficult to imitate and can thus lead to a competitive advantage.	Koufteros et al. (2012); Alfalla-Luque et al. (2015); Shee et al. (2018)
Relational view - RV (Dyer & Singh, 1998)	The frequent interactions with supply chain partners and the joint development of processes and activities allow firms to acquire new resources they lack in-house.	Devaraj et al. (2007); Wiengarten et al. (2016); Zhu et al. (2018)
Organizational information processing theory - OIPT (Lawrence and Lorsch, 1967; Thompson, 1967).	The richer communications developed in the context of SCI may lead to grater opportunities for performance improvement.	Wong et al. (2011); Williams et al. (2013); Wong et al. (2015).
Transaction cost economics - TCE (Coase, 1937; Williamson, 1975)	SCI allows companies to reduce transaction costs, monitoring costs and the costs related to the potential opportunistic behavior of partners thanks to the increased trust between the parties.	Das et al. (2006); Cao et al. (2010); Cao and Zhang (2011).
Knowledge-based view - KBV (Grant, 1996)	The cooperation between actors, the information exchanged between them and the general procedures of SCI make it possible that the different skills and technical expertise of the involved supply chain partners are combined to create new knowledge.	Swink et al. (2007); Blome et al. (2014); Rosenzweig et al. (2003)
Contingency theory (Flynn et al., 2010)	The choices related to integration investments (e.g. when to integrate, which forms of integration to implement, etc.) must be aligned to the external environment of the company and to its internal design.	Koufteros et al. (2005); Danese et al. (2013); Turkulainen and Swink (2017)
Configurational theory (Drazin et al., 1985)	SCI is a multi-dimensional construct including a mix of different integration activities that can be implemented with different levels of advancement. There is a specific mix of practices that provides the maximum performance levels.	Mckone-Sweet and Lee (2009); Danese and Bortolotti (2014); Wong et al. (2017b)

Finally, the last theory that is worth discussing is the knowledge-based view (KBV), which underlines the importance of knowledge as intangible resource (Grant, 1996) and states that, thanks to information sharing and knowledge dissemination, integration practices can create new knowledge, improving organizational capabilities (Danese and Bortolotti, 2014).

Even if all the mentioned theories suggest that SCI is beneficial for companies, scholars started a debate regarding the real effects of integration on performance because of the increasing number of studies finding opposite results. Indeed, besides all the papers confirming the role of integration in reducing cost, improving quality, increasing efficiency, flexibility and delivery, the literature includes many other researches according to which the effect of SCI on performance can be insignificant or even negative (e.g., Swink et al., 2007). As suggested also by some literature reviews (Fabbe-Costes and Jahre, 2008; van der Vaart and van Donk, 2008), caution on this topic is advisable.

One of the causes of these misaligned results can certainly be traced back to the variety of constructs used to measure not only SCI, but also performance results. These latter can be distinguished according to the focus on operational or financial measures. Operational performance is typically expressed in terms of cost, delivery, flexibility and quality, which are either combined into a single measure (e.g. Flynn et al., 2010) or investigated as independent dimensions (e.g. Danese and Bortolotti). Financial performance includes instead measures related to market share, profit, Return on Sales (ROS), Return on Investments (ROI), etc. (see e.g. Adams et al., 2014).

However, researchers agree that the main reason explaining the opposite results found in the SCI field is linked to the context where the focal company operates, arguing that similar levels of integration do not always have the same effects on performance, because SCI practices do inevitably interface with the business context, external environment and/or other practices a company implements (see e.g. Danese et al., 2013; Wiengarten et al., 2014). Different methodologies to study the role of context in the SCI field have been adopted by scholars and, given their widespread use in the literature, three of them deserve a special attention.

One of the most common methodology consists in the application of the contingency theory (see Table 2.1), according to which there is no tactic or strategy that can be successfully applied in all contexts, since the firm’s environment shapes its structures and processes and requires an appropriate organizational design (Flynn et al., 2010). Applied to the SCI field, this theory suggests that SCI practices do not necessarily provide performance improvements, but their effect depends on the value of a third variable, the so-called moderator. Several moderators have been investigated and tested by researchers in order to better understand the relationship between integration and performance and they include factors linked to the external supply chain’s environment, like uncertainty (Koufteros et al., 2005) or complexity (Gimenez et al., 2012),

country-related factors, like the logistical capabilities of the country (Wiengarten et al., 2014), and other supply chain integration practices (Schoenherr and Swink, 2012).
Another approach used to explore the role of context is the use of the configurational theory (see Table 2.1), which claims that an organization is a set of interrelated activities and its success depends on the consistency between them (Drazin et al., 1985). In other words, this means that there must be a coherent mix of supply chain management activities, involving different actors, in order to maximize performance (Flynn et al., 2010).
Finally, the context has been investigated also by analyzing the so-called "black box" between SCI and performance, namely by identifying the factors (the so-called mediators) through which integration affects performance. Some studies explore the indirect effect of SCI through other operational practices, like lean or just-in-time (Prajogo et al., 2016), while many other papers investigate if the benefits of IT-based integration are transferred through other integration practices (Sanders, 2007).
In most of the mentioned studies, the results show that SCI affects performance by interacting with many internal and external factors. Therefore, even if the theme is mature and the contributions are several, the debate on the integration-performance link is still open and many contributions on the role of context can still be provided.

2.2 Sales and Operations Planning

Sales and Operations Planning (S&OP) is a key process aimed at improving coordination and communication between business functions (Goh and Eldridge, 2019) and, as such, is considered one of the most important forms of internal integration (see e.g. Thomé et al., 2014). The APICS dictionary describes S&OP as follows: "The process brings together all the plans for the business (sales, marketing, development, manufacturing, sourcing and financial) into one integrated set of plans. … Executed properly, the sales and operations planning process links the strategic plans for the business with its execution and reviews performance measures for continuous improvement." (APICS Dictionary, 14th Edition, 2013, p. 154). This quotation highlights the two main functions of the S&OP process. On one hand, it guarantees a horizontal alignment of plans, balancing, in particular, customer demand with supply capabilities (Tuomikangas and Kaipia, 2014). On the other, it also allows to bridge the gaps between the long-term business or strategic plans and the short-term operational plans of the firm, realizing a complete vertical alignment (Thomé et al., 2012). Figure 2.1 graphically shows the twofold role of S&OP, underlining its positioning at the tactical level aimed at synchronizing all functional plans and departmental activities of the company.

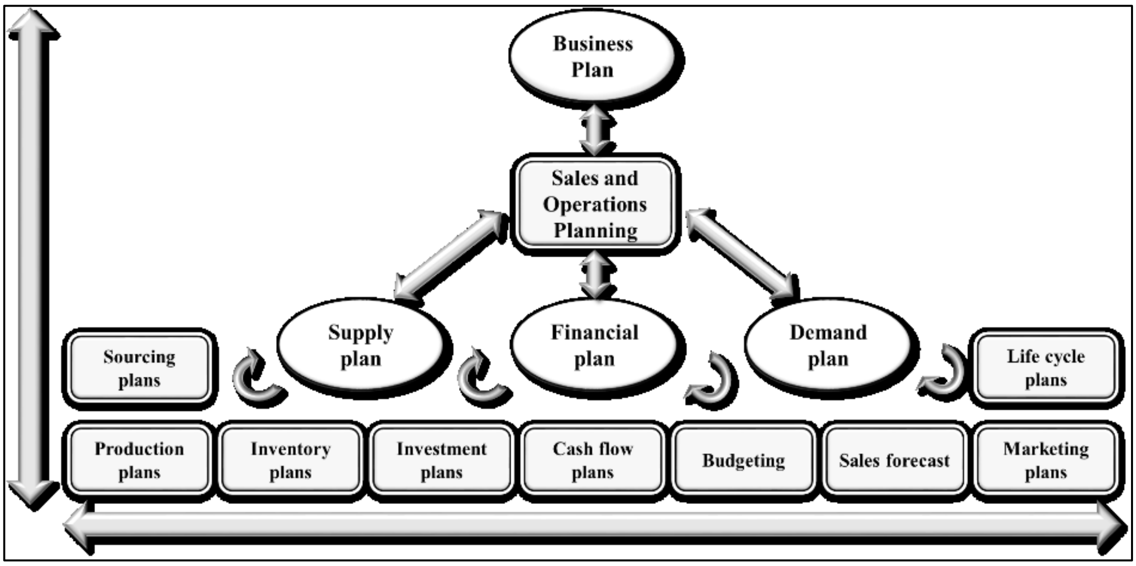

Figure 2.1 Alignment of plans through S&OP (Wagner et al., 2013)

The origins of S&OP go back to the 1980s, when the process started substituting some functionalities of the traditional supply chain planning processes (Olhager, 2013). It then progressively evolved into wider conceptions of business integration (Ambrose et al., 2018) and nowadays, thanks to the Internet and the new technologies, it has expanded its scope to the entire supply chain, aiming at aligning not only internal functions but also supply chain partners (Goh and Eldridge, 2015).

The S&OP is performed at the product family level, with a monthly or weekly frequency, and it creates plans for the next 15-18 months (Grimson and Pyke, 2007). The typical steps of the process are five and they involve cross-functional planning teams with representatives of all main business functions, including finance (Wagner et al., 2014; Ambrose et al., 2018). These steps can be described as follows (see Wagner et al., 2014; Hultén et al., 2016):

- Data gathering

  During this first step, all data of the previous month are collected and spread among the company, together with the value of some Key Performance Indicators (KPIs) related to all the business functions of the firm. In addition, a baseline (i.e. unconstrained) demand forecast is created by the sales and marketing personnel to capture the future requirements of the customers (Grimson and Pyke, 2007).
- Demand planning

  In the demand planning phase, the unconstrained demand forecast previously generated is converted into a demand plan, by considering new product introduction and cannibalization effects, promotional activities or other economic situations (Wagner et al., 2014). The main characteristic of this demand plan is its complete independence from the company's operational capabilities.

- Supply planning
  In the third phase, the feasibility of the demand plan is evaluated through the generation of a supply plan. According to Wallace and Stahl (2008), if customers' requirements exceed company's capacity, different scenarios can be developed and evaluated to identify the best compromise between market demand and operational constraints.
- Pre-meeting
  The pre-meeting consists in reviewing plans, decisions, recommendations and scenarios previously generated and in developing a financial plan that will be presented to the following executive meeting (Thomé et al., 2012).
- Executive meeting
  In this final step, the executive board meets to review and evaluate the decisions taken in the previous step, as well as to reach a consensus on eventual problems arose during the S&OP implementation (Wagner et al., 2014). The final plans are confirmed and shared among the business functions.

Scholars generally agree that S&OP, if properly implemented, can provide several benefits to companies. Indeed, besides improving the alignment between sales and production plans, S&OP allows to reach higher customer satisfaction, reduce inventory levels, increase forecast accuracy and stabilize production rates (Thomé et al. 2012; Wagner et al., 2014; Goh and Eldridge, 2019). In addition, it can reduce order lead times for new products (Goh and Eldridge, 2015) and improve the overall quality of planning processes (Oliva and Watson, 2011). Taken together, these benefits lead to a better financial situation, an increased profit margin and an overall competitive advantage (Hultén et al., 2016; Kristensen and Jonsson, 2018).

Despite these proven benefits, the implementation of a good S&OP in companies is still a challenging task (Swaim et al., 2016). The main reason can be traced back to the pervasiveness of S&OP, which requires the involvement of different departments at different levels. The biggest tensions arise at the interface between the sales and operations groups, because, as underlined by Ambrose et al. (2018), these functions think in different ways, speak different business languages and are evaluated with different, and often opposite, performance indicators. Furthermore, a good S&OP requires also a strong investment in different types of enablers, from top management support and personnel training, to the development of an appropriate organizational structure and the assignment of clear roles and responsibilities (Pedroso et al., 2016). An absence of such fundamental antecedents may result into a loss of all the described potential benefits.

In order to distinguish among different levels of development of S&OP and identify appropriate paths for process improvements, several scholars have proposed a classification of S&OP

advancement through the so-called maturity models (Goh and Eldridge, 2019). These tools require the identification of a certain number of dimensions, which describe and characterize the process, and a certain number of maturity levels, which represent evolutionary stages in the advancement of S&OP (Lapide, 2005). Each dimension assumes particular characteristics in each maturity stage, building a path from an absence of S&OP to a complete integration of plans. During the years, several maturity models have been proposed in the literature (e.g. Lapide, 2005; Grimson and Pyke, 2007; Wagner et al., 2014). They differ from each other not only by the type and number of dimensions, but also by the number of maturity stages considered. Table 2.2 shows Grimson and Pyke's (2007) maturity model, which is considered a point of reference in the S&OP maturity models (Goh and Eldridge, 2015). As we can see from the table, it includes five dimensions developed along five maturity levels. Moving from Stage 1 to Stage 5, the process is progressively improved not only internally, but also externally, involving supply chain partners and aiming at creating value at the supply chain level. Models like this can be used not only to assess the maturity level of the process, but also to plan the transition towards advanced maturity stages: indeed, by looking at the characteristics of S&OP dimensions in the following levels, a company can identify some general recommendations to build the improvement process.

A last thing that is worth emphasizing is the role that context plays also in the S&OP effectiveness. The contributions on this topic are still limited, if compared to the supply chain integration literature, but the idea that "one-size-fits-all" design of S&OP is not adequate in all contexts has progressively grown (see e.g. Ivert et al., 2015a). Industry, dynamic complexity, detail complexity and organizational characteristics are all variables that may affect S&OP design and must then be taken into consideration when developing this process (Kristensen and Jonsson, 2018).

Table 2.2 Grimson and Pyke's (2007) maturity model

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

Chapter 3
THESIS RATIONALE AND LOGICAL DEVELOPMENT

This section provides a short description of the three papers belonging to the thesis collection that are grounded on the literature previously discussed. The aim is to guide the reader through the development of the PhD research and the related logical phases.

The first paper derives from the opposite results obtained by scholars about the relationship between SCI and performance (see Section 2) and consists into the realization of a Systematic Literature Review (SLR) aimed at better understanding how the above relationship is influenced by context. The aim is to achieve the first goal of the PhD research (i.e. "To investigate the role of context in shaping the relationship between supply chain integration and performance").

The second and third papers use the results found in the SLR to address the other two goals of the PhD research. The second paper deals with the second goal (i.e. "To understand how to properly implement supply chain integration"), focusing on the implementation of an important form of internal integration, the Sales and Operations planning, which is investigated using the multiple case study approach.

Finally, the third paper considers an external form of SCI, supplier integration, and empirically analyzes how the choices related to the supply network design and, in particular, the supply base size, influence the effects of supplier integration on performance. With this paper, also the last goal of the PhD research is addressed (i.e. "To identify and empirically investigate contingent factors that interact with supply chain integration to provide the maximum performance benefits to companies").

Table 3.1 provides a summary of the three papers that are described with a deeper detail in the following subsections.

Table 3.1 Papers included in this PhD thesis

	Paper 1	**Paper 2**	**Paper 3**
PhD Goal	1. To investigate the role of context in shaping the relationship between supply chain integration and performance.	2. To understand how to properly implement supply chain integration.	3. To identify and empirically investigate contingent factors that interact with supply chain integration to provide the maximum performance benefits to companies.
Paper tytle	Modelling fit in supply chain integration: a systematic literature review on context, practices, performance links.	Managing evolutionary paths in Sales and Operations Planning: key dimensions and sequences of implementation.	Implementing supplier integration practices to improve performance: the contingency effects of supply base reduction.
Research questions / research hypotheses	In existing research on the fit between context, SCI, and performance: (RQ1) What are the most investigated contextual factors and main results found? (RQ2) What are the most under-explored and unsolved issues? Based on this: (RQ3) What alternative theoretical lenses or perspectives can be adopted to cover the identified gaps? (RQ4) What alternative approaches can be used to address the unsolved issues and advance our knowledge on the SCI-performance link?	(RQ) What are the dynamics of interactions among the S&OP dimensions in maturity models during the transition from a maturity stage to the following one?	HP1: Supplier development has a positive effect on (a) efficiency and (b) innovation. HP2: Supplier involvement in NPD has a positive effect on (a) efficiency and (b) innovation. HP3: Operational coordination has a positive effect on (a) efficiency and (b) innovation. HP4: IT integration has a positive effect on (a) efficiency and (b) innovation. HP5: A reduced supply base strengthens the positive effect of supplier development on (a) efficiency and (b) innovation. HP6: A reduced supply base strengthens the positive effect of supplier involvement in NPD on (a) efficiency and (b) innovation. HP7: A reduced supply base strengthens the positive effect of operational coordination on (a) efficiency and (b) innovation. HP8: A reduced supply base strengthens the positive effect of IT integration on (a) efficiency and (b) innovation.

Table 3.1 (continued)

	Paper 1	Paper 2	Paper 3
Research type / Methodology	Conceptual / Systematic Literature Review	Empirical / Multiple case study	Empirical / Survey
Final dataset	90 papers published between January 2000 and December 2018 in high-quality journals.	3 companies operating in different B2B sectors, characterized by a different starting level of S&OP maturity, and willing to invest to further develop their S&OP process.	324 plants from 15 countries located in Europe, Asia and America, belonging to the mechanical, electronics and transportation equipment sectors (SIC codes: 35, 36 and 37).
Analysis	Deductive papers' classification based on Venkatraman's (1989) fit framework and qualitative content analysis.	Within-case analysis and cross-case analysis.	Confirmatory factor analysis and hierarchical regression analysis.
Findings	The most used forms of fit are mediation and moderation. Some examples of popular research topics include the role of SCI as a prerequisite for other operations and supply chain management practices, or the moderating role of uncertainty/ complexity in influencing SCI benefits. There is "white space" for future research in several fit forms (e.g. adopting alternative theories or perspectives); many promising research opportunities come also from the less used fit forms and from combinations of multiple fit forms.	The transition to a more advanced S&OP maturity stage requires a balanced execution of all the key dimensions, but it makes no sense to search for a unique and best temporal sequence of implementation. Specifically, the degree of seriality vs parallelism among actions on different S&OP dimensions during the transition depends on the evolution stage of S&OP process. Finally, the "organisation and people" dimension acquires an increasing importance as the maturity level increases.	Most SI dimensions do not have a significant effect on efficiency and innovation. The only exceptions are supplier involvement in NPD, that positively affects both efficiency and innovation, and IT integration, that has an unexpected negative effect on efficiency. Supply base reduction moderates almost all the relationships between SI dimensions and performance. These results indicate that, in order to maximize efficiency and innovation, there must be a consistency between SI and supply base reduction decisions.

3.1 First paper – Literature review

The first paper aims at shedding light on the relationship between supply chain integration and operational and financial performance. Indeed, as it emerged also in the theoretical background provided in the previous section, the literature is not unanimous in supporting the benefits of SCI and the contrasting findings obtained by scholars make the debate on the issue still noteworthy. A central belief that has progressively grown over the years is that the context where a company operates plays a fundamental role in shaping the relationship between integration and performance and, for this reason, several studies have moved the focus from the relationship itself to the role of context. Since no one has attempted to provide an overview of these contributions and to synthetize the related findings, this PhD project started with the realization of a Systematic Literature Review (SLR), as proposed by Tranfield et al. (2003), that offers a comprehensive state-of-the-art of research on the fit between context, SCI practices and performance.
In particular, four research questions guided the review and are articulated as follows.
In existing research on the fit between context, SCI, and performance:
(RQ1) What are the most investigated contextual factors and main results found?
(RQ2) What are the most under-explored and unsolved issues?
Based on this:
(RQ3) What alternative theoretical lenses or perspectives can be adopted to cover the identified gaps?
(RQ4) What alternative approaches can be used to address the unsolved issues and advance our knowledge on the SCI-performance link?
An element of originality of the SLR is the classification of papers based on Venkatraman's (1989) fit scheme. Ensign (2001, p. 287) defines fit as "an internal consistency among key strategic decisions or the alignment between strategic choices and critical contingencies with the environment (external), organization (internal), or both (external and internal)". Over the years, the concept of fit has been extensively used in strategy research assuming different forms, useful for studying fit, congruence or coalignment (different words can be found) between strategy, context and performance. In general, today, the concept of fit has a huge importance in management disciplines, and it was applied to develop many middle range theories (Venkatraman and Kamillus, 1984) and for theory construction in several fields (Blarr, 2012). Venkatraman's (1989) fit framework, which is among the most frequently used and, according to Blarr (2012), the most complete and advanced one, classifies fit into six forms: mediation, moderation, matching, gestalts, profile deviation and covariation, using two dimensions: specificity and anchoring. Specificity refers to the level of precision in the functional form of fit, indicating the number of variables that can be specified in modeling the fit; for example, fit as moderation normally involves two (or few) variables and their interaction (high specificity), whereas gestalts

involves many variables, resulting in a low specificity. Anchoring refers instead to anchor the concept of fit to a particular criterion (typically performance) in contrast to adopting a criterion-free specification. The reader can refer to Table 4.1 for a deeper description of the six fit types. By classifying previous papers on context, SCI, and performance according to this framework, the SLR not only examines the results found and the opportunities for future research within each fit category, but it also identifies the potentialities of innovative and less used fit forms in addressing some open and unsolved issues in SCI. The research concludes that the most used forms of fit are mediation and moderation. Some examples of popular research topics include the role of internal integration as a prerequisite for external integration, and the moderating role of uncertainty/complexity in influencing SCI benefits. There is also "white space" for future research opportunities in several areas: 1) the adoption of a Behavioral Operations perspective and Institutional Theory to study SCI antecedents, 2) the study of national culture and supply network structure as moderators of the SCI-performance link. Additional research opportunities come from the less used fit forms (e.g. profile analysis and fit as matching) and from combinations of multiple fit forms that could help to address some unsolved issues in SCI, such as the balance between upstream and downstream integration and optimal SCI profiles.

The arguments discussed can be useful for both academics and practitioners interested in the SCI-performance link and the role of context. Scholars can use this SLR to have a detailed overview of previous research on SCI and performance classified according to an innovative lens and can evaluate several motivated suggestions for future research. Managers can instead benefit from the SLR results by having a more complete understanding of under what conditions SCI can be more useful and of possible negative implications of their integration programs.

3.2 Second paper – Case study

One of the most popular research topics emerged from the SLR of the first paper is the role of internal integration as a prerequisite for external integration. Indeed, the authors studying the fit between internal and external integration are several and almost all of them agrees on the fact that the former facilitates the latter, acting as the foundation for the external forms of collaboration, like supplier and customer integration (e.g. Braunscheidel et al., 2010; Flynn et al., 2010; Mojano-Fuentes et al., 2016). Even if the highest performance improvements can be achieved by implementing a complete supply chain integration (i.e. internal, downstream and upstream), any attempt to integrate suppliers or customers without a proper internal collaboration may be futile (Koufteros et al., 2005) or even generate inefficiencies (Danese and Bortolotti, 2014). From these results, it emerges that internal integration has a key role for company competitiveness and it thus deserves a particular attention in research.

Therefore, in the second paper, the focus of the analyses was moved on the development of one of the most important forms of internal integration: Sales and Operations Planning. The second goal of the PhD research is thus addressed considering this specific type of integration. As already discussed in section 2, S&OP is a process that aims to improve communication and interactions between a company's departments and to develop a single integrated set of plans that are shared and approved by all business functions (Thomé et al., 2012). Despite the huge attention given by the literature to S&OP and its widely recognized benefits, the average level of advancement of the process is quite low in companies and managers still face many challenges during its implementation (Swaim et al., 2016). What lacks in the literature is a tool that helps companies not only to plan the transition towards advanced stages, as the existent maturity models already do, but also to execute this transition, providing guidance on the dynamics of evolution from one stage to the next one. Building on the S&OP maturity models' literature (see section 2.2), the following research objective was thus defined: "to study S&OP transitions between different maturity stages in the evolutionary paths, in order to analyze and develop an understanding of common patterns and differences in the dynamics occurred." To address this issue, the second paper develops an original S&OP maturity model, which is built on previous literature but presents a reorganization of the existing S&OP dimensions in a way that should facilitate the analysis of transitions between maturity stages. The model, which is represented in Chapter 5 (Table 5.2), includes four S&OP dimensions (i.e. People and organization, Process and methodologies, Information technology and Performance measurement) and five maturity stages (i.e. No S&OP process, Reactive, Standard, Advanced, Proactive). The choice of the four S&OP dimensions is linked to a widely recognized sequence, according to which every development or improvement process should start with the involvement of personnel and the reorganization of a company's structure, followed by an eventual redefinition of processes and methodologies, which, only after being tested and standardized, can be automatized through IT tools and monitored with the development of appropriate performance indicators (see Grimson and Pyke, 2007; Bortolotti and Romano, 2012). Since the analysis of S&OP transitions requires accurate information and data about events occurred and their dynamics, the research question is addressed using the multiple case study methodology. In particular, three S&OP transitions with different starting and destination maturity stages are selected. The actions undertaken to realize the change in the three cases are mapped over time and then compared to find common patterns and differences.

The findings show that a successful transition requires a balanced action and performance on all S&OP dimensions, independently from the maturity level. In addition, the actions undertaken to move towards advanced stages tend to follow the hypothesized sequence (People and organization - Process and methodologies - Information technology - Performance measurement), but this latter is too simplistic. Indeed, it emerged that the degree of seriality vs parallelism among actions on different S&OP dimensions during the transitions depends on the evolution stage of S&OP process. While to reach the lower maturity stages the actions can be addressed in an almost pure serial way, the achievement of advanced S&OP levels requires to simultaneously address different dimensions that become more and more interdependent. Finally, the "People and organization" dimension, which is always the starting point for S&OP advancement, acquires an increasing importance as companies move towards advanced maturity stages, because of the organizational pervasiveness of the changes required to people's mentality and organizational structure.

The paper and its results are useful for both academics and practice. From a theoretical point of view, it provides an innovative contribution to the under-explored area related to the dynamics of evolution of S&OP transitions from one maturity stage to the following one. From a managerial point of view, it can help managers to improve the organization of their S&OP advancement, not only by explaining how the S&OP dimensions can interact over time, but also by providing potential causes of failures and barriers of S&OP improvement projects.

3.3 Third paper – Survey

One of the opportunities for future research identified in the SLR is the investigation of additional contingent factors of the SCI-performance relationship, like national culture or supply network structure. The third paper focuses on the latter, investigating how the choices related to the supply network design, and, in particular, supply base reduction, influence the effects of supplier integration on performance. Such a study, besides contributing to the SCI literature, allows also to address the third goal of the PhD research.

Among all the possible factors related to the supply network structure, supply base reduction was chosen because this is a practice that the focal firm has control over, and knowing how it interacts with other managerial practices, like SCI, is important to understand how to manage it for performance maximization. This is an additional contribution to the existing literature because the majority of papers analyzing contingent factors of the supplier integration-performance link are related to the external environment on whom the company has typically little or no control over, like supply uncertainty (Koufteros et al., 2005) or complexity (Caniato and Größler, 2015). In addition, the literature is not clear in suggesting if companies should combine supplier integration practices with initiatives aimed at reducing the supply base, and research explicitly analyzing this synergic effect is scarce. To make the investigation more complete, the third paper also further separates supplier integration into four different dimensions, two strategic, one operational and a technology-based one. Finally, it focuses on efficiency and innovation as dependent variables.

Table 3.1 shows the research hypotheses developed in the study, which are based on an in-depth literature review on (1) supplier integration dimensions, (2) their relationship with performance and (3) the potential moderating role of supply base reduction on the previous relationships. Some of the hypotheses address the main effect of the four supplier integration dimensions on efficiency and innovation, while the others address the contingent effect of supply base reduction. In order to test these hypotheses, the research relies on the data of the fourth round of the High Performance Manufacturing project (HPM). The constructs needed for the study are developed using this database as well as previous literature, and they are validated with a confirmatory factor analysis. The hypotheses are instead tested using a moderated regression analysis, including six control variables: industry, country, firm size, purchasing department size, investments in R&D and supplier selection based on supplier's capabilities.

The results are only partially in line with the literature and the related hypotheses. As concerns the main effects of supplier integration dimensions, it emerged that only supplier involvement in new product development has a significant positive effect on efficiency and innovation (HP2a and HP2b supported), while the effect of IT-based integration is even negative on efficiency (HP4a rejected). In all the other cases, the results are not significant (HP1a, HP1b, HP3a, HP3b and HP4b rejected). As concerns instead the moderation hypotheses, the contingency effect of supply base reduction is confirmed for all the relationships related to efficiency (HP5a, HP6a, HP7a and HP8a supported) and for those between supplier development and innovation (HP5b supported) and between operational coordination and innovation (HP7b supported). The other two hypothesized moderations are not significant (HP6b and HP8b rejected).

These findings, based on a large sample of companies, are novel in the literature and have several implications for both theory and practice. As concerns the former, this research contributes to three main streams of the literature and, in particular, those dealing with: (1) the main effect of supplier integration dimensions on efficiency and innovation; (2) the contingent role of supply base reduction on the relationship between supplier integration and performance; (3) the decisions among single vs multiple sourcing. As concerns the latter, this study warns managers that, in order to maximize performance, they must implement strategic, operational and technology-based supplier integration initiatives together with actions aimed at reducing their supply base. In addition, it also indicates that in the first stages of supplier integration or in absence of such activity, managers should rely on a large pool of suppliers to benefit from the related advantages, but, as integration increases, the number of suppliers must be reduced to fully exploit collaboration's benefits.

Chapter 4
MODELLING FIT IN SUPPLY CHAIN INTEGRATION: A SYSTEMATIC LITERATURE REVIEW ON CONTEXT, PRACTICES, PERFORMANCE LINKS

4.1 Introduction

Supply chain integration (SCI) can be defined as "the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organization processes" (Flynn et al., 2010, p. 59). Given the increasing complexity, dynamism, and internationalization of supply networks, the importance of SCI is nowadays well recognized in both practice and theory (Chaudhuri et al., 2018). Over time, SCI has been widely studied and one of the most investigated issues is its relationship with performance (Alfalla-Luque et al., 2013). Although many authors agree that in general SCI has a positive effect (Kim, 2013), the awareness that SCI may not always be beneficial has progressively grown over the years. The focus of the studies has thus moved from the relationship itself to the role of context, with the aim of understanding how it influences SCI and its effect on performance (e.g., Wong et al., 2015). Papers dealing with this issue are numerous and research on this topic is mature, as the various survey-based studies testify. Scholars reflected on a wide range of contextual variables, from supply network characteristics (e.g., Danese and Romano, 2013), to operations and supply chain management practices (e.g., Ward and Zhou, 2006; Carr and Kaynak, 2007), from innovation orientation (Lii and Kuo, 2016) to national culture (e.g., Wong et al., 2017a). Thus, previous works are fragmented, as they significantly differ in terms of contingencies and research frameworks, as well as in results. For this reason, we think that the *momentum* is appropriate for providing comprehensive state-of-the-art research on the link between context, SCI practices, and performance. Previous literature reviews on SCI do not address this topic, but deal with definitions and measures of SCI (Fabbe-Costes and Jahre, 2007; Alfalla-Luque et al., 2013), its drivers (Kamal and Irani, 2014), or the integration-performance relationship in general (van der Vaart and van Donk, 2008; Kim, 2013). There is also a consistent number of meta-analyses on SCI, investigating the relation between different forms of SCI and performance (e.g. Leuschner et al., 2013; Mackelprang et al., 2014; Chang et al., 2016; Ataseven and Nair, 2017). Among these studies, only Chang et al. (2016) consider the role of context, although their analysis is limited to few contextual variables. The present Systematic Literature Review (SLR) differs from these previous works, as it intends to deeply investigate the role of context in shaping the relationship between SCI and performance. With the term "context", we refer to both environmental contingencies external to the company, and internal ones, like the concurrent implementation of different SCI and/or other operations practices (e.g., lean, product modularity).

Four Research Questions (RQs) guided this review and are articulated as follows.

In existing research on the fit between context, SCI, and performance:

(RQ1) What are the most investigated contextual factors and main results found?

(RQ2) What are the most under-explored and unsolved issues?

Based on this:

(RQ3) What alternative theoretical lenses or perspectives can be adopted to cover the identified gaps?

(RQ4) What alternative approaches can be used to address the unsolved issues and advance our knowledge on the SCI-performance link?

In order to address these questions, we used Venkatraman's (1989) fit scheme to classify papers; this method provides an element of originality in this SLR. According to Ensign (2001, p. 287), the term fit can be described as "the alignment between strategic choices and critical contingencies with the environment (external), organization (internal), or both (external and internal)." Venkatraman's (1989) fit framework classifies fit into six forms based on two dimensions: specificity and anchoring (Table 4.1).

Table 4.1 Classification of the six fit forms (taken from Venkatraman, 1989)

Specificity	*Low*	**Fit as Profile Deviation** implies the existence of an ideal profile in practice adoption and claims that the degree of adherence to this profile has a significant effect on a specific criterion, e.g., performance.	**Fit as Gestalts** implies the existence of an internal coherence among a set of theoretical attributes. According to this perspective, it is possible to identify a certain number of clusters with similar values for some variables.
	Medium	**Fit as Mediation** hypothesizes the existence of an intermediate mechanism between an antecedent variable and a consequent variable.	**Fit as Covariation** refers to the internal consistency among a set of underlying related variables and consists in creating a second-order construct that captures complementarities arising from the selected variables.
	High	**Fit as Moderation** presumes that the relationship between a predictor and a criterion variable depends on the level of a third variable (i.e., the moderator) that can influence the strength of the relationship.	**Fit as Matching** implies the existence of a theoretically defined match between two related variables. The measure of fit can be derived only from theory without a reference to performance.
		Criterion-specific	*Criterion-free*
		Anchoring	

Specificity refers to the level of precision in the mathematical function used to model fit and depends on the number of variables specified, while anchoring refers to the linkage of fit to a particular criterion (typically performance) in contrast to adopting a criterion-free specification.

We decided to rely on Venkatraman's framework because it offers a structured way to classify research on SCI, providing insights on conceptual models used to investigate the relationships between different contextual variables, SCI, and performance. This allowed us not only to analyze results achieved and the potential "white space" for future research within each fit category, but also to understand the potentialities of innovative and less used fit forms, which could be useful to address some open and unsolved issues in SCI.

This SLR can be relevant for both academics and practitioners. It provides scholars with a detailed overview of previous research on context, SCI, and performance, classified according to an original lens, and with several suggestions for future research. Managers can instead benefit from a more complete understanding of the conditions under which SCI practices can be more effective.

This paper is structured as follows. The next section describes the research methodology. Then, we examine and compare the selected SCI papers, classified following Venkatraman's (1989) framework, in order to identify the contingencies investigated and common issues, as well as under-explored areas. Based on this, we critically discuss possible opportunities for future research and provide some suggestions to further apply the concept of fit in the SCI literature to study promising or under-investigated topics. The conclusions summarize the theoretical and managerial implications of this SLR, as well as the research limitations.

4.2 Methodology

This paper applies the SLR method to select and analyze the articles, as proposed by Tranfield et al. (2003). This methodology has been successfully used in many recent literature reviews on different topics, which range from SCI (e.g., Kamal and Irani, 2014; Wong et al., 2015c) to Sales and Operations Planning (e.g., Tuomikangas and Kaipia, 2014) and innovation (Adams et al., 2015). Its advantage is that it overcomes the weaknesses of a narrative review (Tranfield et al., 2003), being more rigorous, systematic, and structured in the paper selection. In addition, it is widely recognized that the SLR approach provides several benefits, such as improvement of quality in both process and outcomes (Mihalache and Mihalache, 2015), minimization of errors and bias (Tranfield et al., 2003), and opportunity to rigorously synthetize and organize the literature published on a certain topic (Wang and Chugh, 2014). We followed a structured process consisting of the steps described in Figure 4.1, which represents a well-known procedure used in several SLRs (e.g., Wang and Chugh, 2014; Nolan and Garavan, 2016). In the following sections, we provide a short description of these steps.

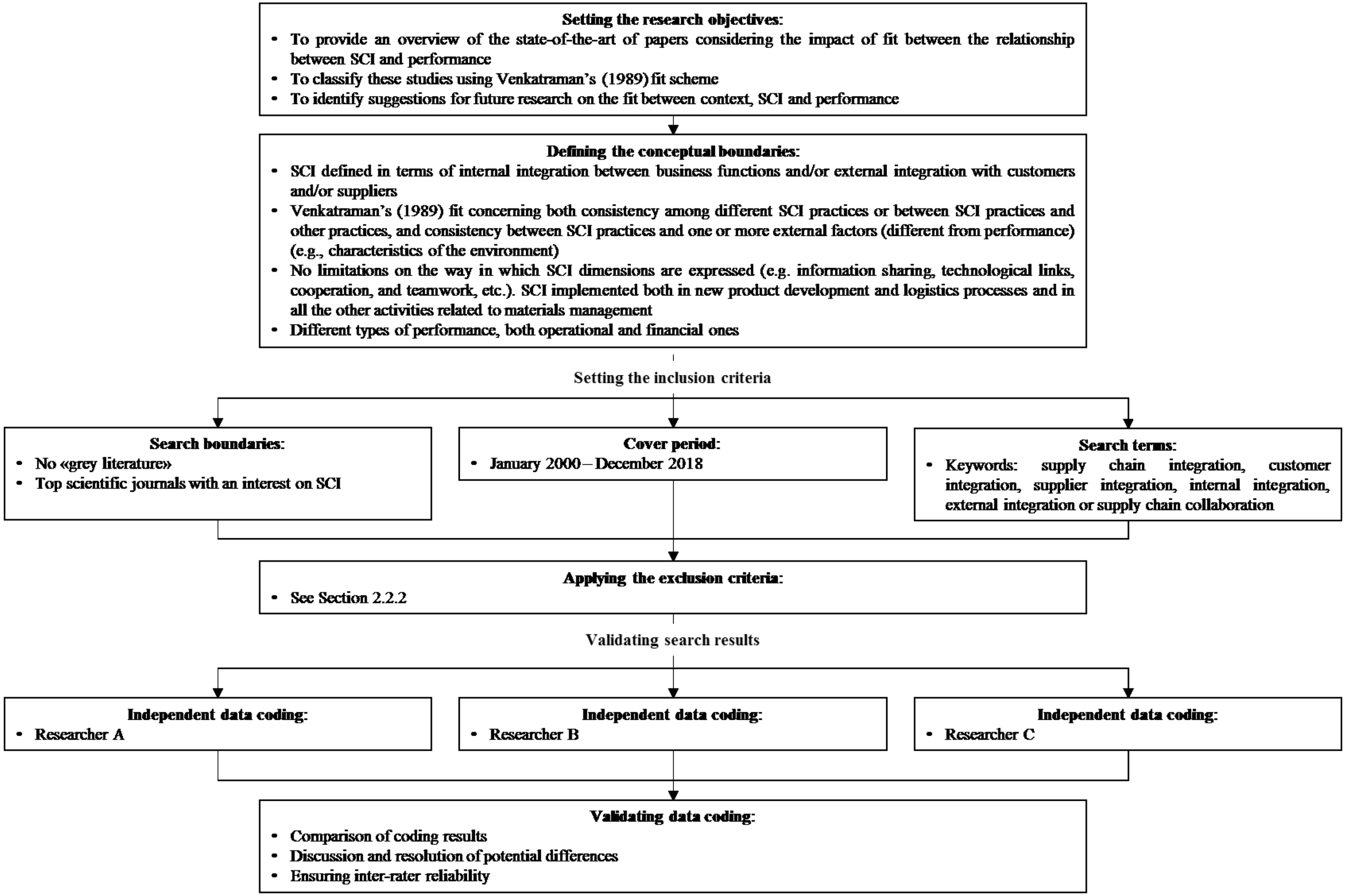

Figure 4.1 A summary of the SLR process

4.2.1 Conceptual boundaries

The boundaries of the review were defined in line with our research objectives. As regards the SCI practices analyzed, we focused on internal and external practices, referring to the integration between business functions and integration with customers and/or suppliers, respectively. We did not define any limitation on the way in which these dimensions were expressed, meaning that they could be described in terms of information sharing, technological links, cooperation, and teamwork, etc., and implemented both in new product development and logistics processes and in all the other activities related to materials management. Given the purpose of this research, each paper selected had to consider performance. In line with previous literature reviews on SCI and performance (e.g., van der Vaart and van Donk, 2008) and given our intention to provide researchers and practitioners with a broad overview of studies dealing with fit between context, SCI, and performance, we decided to include papers considering different types of performance, both financial and operational ones.

In addition, we selected only papers in which fit concerned both consistency among different SCI practices (e.g., between customer integration and internal integration) or between SCI practices and other practices (e.g., lean adoption), and consistency between SCI practices and one or more external factors other than performance (e.g., characteristics of the environment). Thus, we excluded those papers considering operational performance or competitive capabilities as intermediate mechanisms to improve financial or business performance, such as Chang et al. (2016) and Swink et al. (2007). Finally, we considered only quantitative papers, particularly those applying survey-based studies, because the six fit categories described by Venkatraman (1989) require the application of statistical testing and so need to be investigated through a large sample of observations.

4.2.2 Data collection: inclusion and exclusion criteria

The collection process required the application of some inclusion and exclusion criteria regarding the selection of journals, time range, and articles.

4.2.2.1 Journals selection

In line with David and Han (2004) and Kim and Aguilera (2016), we considered only published peer-reviewed journals in English language and so we excluded all other document types (i.e. trade publications, books, book chapters, conference proceedings, etc.). Afterwards, in order to identify the most appropriate journals for our high-quality review, we based on some additional criteria (published by the Italian Association of Management Engineering), as it follows. First of all, the journals had to belong to at least one of the following repertories:

- ABS (Academic Journal Guide);
- CNRS (Journal ranking in Economics and Management);
- WoS/ISI in one of the following categories: Business, Business & Finance, Economics, Management, Public Administration, Operations Research & Management Science;
- SCOPUS/SCIMAGO in one of the following categories: Business, Management & Accounting, Economics, Econometrics & Finance, Public Administration, Management Science & Operations Research.

Then, we considered a journal ranking resulting from the combination of WoS/ISI and SCOPUS/SCIMAGO quartiles and ABS and CNRS merit classes. We remind to the readers that WoS/ISI quartiles are based on JCR Impact Factor and SCOPUS/SCIMAGO quartiles refer to the SJR Indicator. For every repertory, a value between 1 and 4 is assigned to every journal: an evaluation of 4 means that the journal belongs to the highest quartile/merit class, while an evaluation of 1 means that it belongs to the lowest quartile/merit class. Starting from this, we selected only the journals satisfying the following criteria:

- Having a score of 4 in at least one of the repertories WoS/ISI, ABS, CNRS;
- Having a score of 3 in the repertoires WoS/ISI, ABS, CNRS and at least 3 in SCOPUS/SCIMAGO.

This procedure led to the selection of 299 high-quality journals. From this list, we focused on the journals having a particular interest in the topic of SCI, selecting those that:

- Have at least one paper on integration topics in the section: "Most cited papers" (e.g., Journal of Supply Chain Management, Supply Chain Management: An International Journal) or in the section "Most downloaded papers" (e.g., International Journal of Production Economics) or in the sections "Most popular" or "Best articles" or
- Have an interest in the integration within and between firms clearly expressed in the scope of the journal (e.g., Journal of Operations Management, International Journal of Operations and Production Management).

At the end of this process, we selected the 17 peer-reviewed journals listed in Table 4.2.

4.2.2.2 Time range and paper selection

Since the aim of the research is to provide an overview on the latest contributions on SCI, only recent literature published between January 2000 and December 2018 was considered.

The SCOPUS database was used for the selection of relevant papers, which had to include one of the following: "supply chain integration", "customer integration", "supplier integration", "internal integration", "external integration" or "supply chain collaboration", in the article title, abstract or keywords. These keywords used in database search were selected in order to ensure a broad coverage of previous research on SCI and are coherent with the those used in previous literature reviews (e.g., Kim, 2013) and meta-analyses on SCI (e.g. Leuschner et al., 2013).

Table 4.2 Journals and papers included in the SLR

Journals	Papers
Decision Sciences (n = 5)	Koufteros et al. (2005) Swink et al. (2005) Ward and Zhou (2006) Koufteros et al. (2010) Srinivasan and Swink (2015)
Decision Support Systems (n = 1)	Chavez et al. (2015)
Human Resource Management (n = 1)	Braunscheidel et al. (2010)
Industrial Marketing Management (n = 1)	Kim et al. (2013)
International Journal of Operations and Production Management (n = 16)	Salvador et al. (2001) Vereecke and Muylle (2006) Carr and Kaynak (2007) Jacobs et al. (2007) Gimenez et al. (2012) Van der Vaart et al. (2012) Danese and Romano (2013) Liu et al. (2013) Wiengarten et al. (2013) Blome et al. (2014) von Haartman and Bengtsson (2015) Prajogo et al. (2016) Vanpoucke et al. (2017) Chaudhuri et al. (2018) Zhu et al. (2018) Ebrahimi et al. (2018)
International Journal of Physical Distribution and Logistics Management (n = 1)	Boon-itt and Wong (2011)
International Journal of Production Economics (n = 19)	Kim (2009) Li et al. (2009) Droge et al. (2012) Prajogo and Olhager (2012) Wong et al. (2013) Wu et al. (2014) Alfalla-Luque et al. (2015) Wong et al. (2015a) Wong et al. (2015b) Huo et al. (2016) Kauppi et al. (2016) Lii and Kuo (2016) Wiengarten et al. (2016) Dai et al. (2017) Liao et al. (2017) Wong et al. (2017a) Wong et al. (2017b) Jajja et al. (2018) Kumar et al. (2018)

Table 4.2 (Continued)

Journals	Papers
International Journal of Production Research (n = 4)	Cao et al. (2010) Danese and Romano (2011b) Liu et al. (2012) Danese and Bortolotti (2014)
Journal of Business Logistics (n=3)	Springinklee and Wallenburg (2012) Adams et al. (2014) Swink and Schoenherr (2015)
Journal of Business Research (n = 1)	Ragatz et al. (2002)
Journal of Operations Management (n = 16)	Dong et al. (2001) Frohlich and Westbrook (2001) Vickery et al. (2003) Droge et al. (2004) Das et al. (2006) Devaraj et al. (2007) Sanders (2007) Swink and Nair (2007) Germain et al. (2008) Mishra and Shah (2009) Flynn et al. (2010) Cao and Zhang (2011) Wong et al. (2011) Schoenherr and Swink (2012) Williams et al. (2013) Wiengarten et al. (2014)
Journal of Purchasing and Supply Management (n = 4)	Fynes et al. (2004) Bruque-Càmara et al. (2016) Sáenz et al. (2018) Shou et al. (2018)
Journal of Supply Chain Management (n = 4)	McKone-Sweet and Lee (2009) Koufteros et al. (2012) Turkulainen and Swink (2017) Kim and Schoenherr (2018)
Omega (n = 1)	Danese (2013)
Production Planning and Control (n = 3)	Baihaqi and Sohal (2013) Caniato and Größler (2015) Moyano-Fuentes et al. (2016)
Supply Chain Management: An International Journal (n = 9)	Kim (2006) Quesada et al. (2008) Kannan and Tan (2010) Danese and Romano (2011a) Huo (2012) Seo et al. (2014) Pradabwong et al. (2017) Shee et al. (2018) Michalski et al. (2018)
Transportation Research Part E (n = 1)	Danese et al. (2013)

The abstracts of all resulting papers were then assessed. In line with the research objectives and conceptual boundaries, the following exclusion criteria were applied. We excluded:

- Papers that do not consider performance: in particular, for the criterion-anchored fit types (Table 4.1), we verified that the selected criterion was performance, while for those not anchored to a reference criterion, we required that performance was explicitly included in the analysis;
- Papers adopting methodologies different from survey-based research (e.g., case study, literature review, etc.);
- Papers in which SCI is not expressed in terms of internal and/or external integration (where the former concept refers to the integration between business functions and the latter concerns the integration with customers and/or suppliers);
- Papers in which fit models do not satisfy our conceptual boundaries (see Section 4.2.1).

When the information included in the abstract was not sufficient for these evaluations, we examined the full paper to collect missing data and take the final decision.

Our final sample includes 90 articles published between January 2000 and December 2018 in 17 peer-reviewed journals, whose recurrence is provided in Table 4.2.

4.2.3 Content analysis and validation

We read the full text of these 90 papers and used a combination of deductive and inductive processes to analyze and categorize them. First, we explored the dimensions of integration considered in the selected papers. With an inductive approach, we identified different forms of integration and coded papers accordingly, depending on the direction of integration (e.g., customer integration, supplier integration, etc.), the type of integration (e.g., information sharing, technological integration, etc.) and the process involved (e.g., new product development, and integrated logistics) (see section 3.1). In addition, we deductively classified papers according to the fit they used. Not all papers explicitly referred to and cited Venkatraman (1989); in these cases, we classified the forms of fit applied based on the research framework tested. For each fit form, we then analyzed the contextual variables investigated and, for the most used forms of fit, we inductively identified some contextual macro-categories in order to synthetize results, compare papers and find patterns. At this point, each researcher read all the papers again and for each of them he/she independently:

- Associated the dimensions of integration and contextual variables analyzed in each paper to the categories previously identified, and assigned to each paper the respective codes;
- Recorded into a Microsoft Excel file for each paper the following information: authors' names, year of publication, academic journal, SCI and performance dimensions considered, method used for statistical analyses, theoretical lenses supporting the studies (if any), country and sector of sampled companies, effects analyzed, and main findings.

After that, the researchers met and discussed possible issues until convergence for each paper was achieved (Figure 4.1). To ensure process consistency, we also computed Krippendorff's Alpha index, (Krippendorff, 1970). The values for this index were well above the suggested threshold of 0.8, confirming the validity of the inter-reliability process.

4.3 Results and findings

4.3.1 Descriptive analysis

In this section, we provide a brief overview of the papers analyzed through the SLR, giving some information regarding distribution of articles over time, types of SCI and performance dimensions used, statistical methodologies, theoretical lenses supporting the studies, and country and industry settings.

Based on Figure 4.2, we can see that there is a growing trend in the quantitative papers analyzing the role of context in the SCI-performance relationship, with a peak in 2012-2013 and then a slight decline until 2018, when the number of publications grows again and reaches the maximum level.

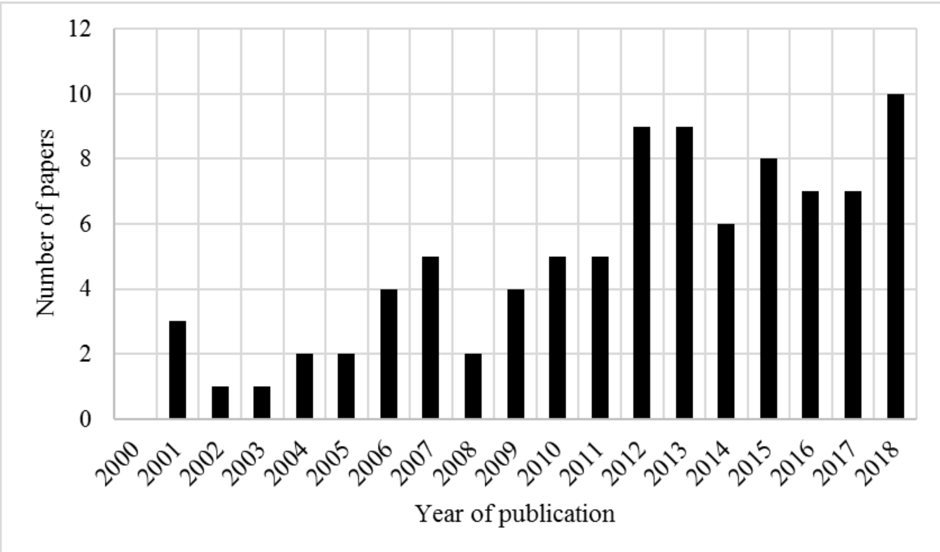

Figure 4.2 Distribution of papers by year of publication

As regards the sources of publication (see Table 4.2), it emerges that three journals have the highest number of papers dealing with our research topic: *Journal of Operations Management*, *International Journal of Production Economics* and *International Journal of Operations and Production Management*. The 51 papers published in these three journals account for 57% of the total number of the reviewed papers. Finally, almost half of the journals (7 out of 17) include just one paper each.

An important point concerns the measures of integration and performance used in the reviewed studies. Some authors consider financial performance (Flynn et al., 2010) while others measure operational performance, both as a single scale combining different performance dimensions together (Devaraj et al., 2007) and using multiple scales for each performance dimension, such as quality, delivery, flexibility, and cost, etc. (Schoenherr and Swink, 2012).
Similarly, a variety of measures of the SCI construct is displayed (see Table 4.3).

Table 4.3 Forms of integration used in the reviewed papers

	NPD	LOG
IT	Ragatz et al. (2002)[SUP]; Caniato and Größler (2015)[INT]	Dong et al. (2001)[SUP]; Frohlich and Westbrook (2001)[SUP,CUS]; Salvador et al. (2001)[SUP,CUS]; Kim (2006)[INT,SUP,CUS]; Carr and Kaynak (2007)[INT]; Sanders (2007)[INT]; Quesada et al. (2008)[SUP,CUS]; Kim (2009)[INT,SUP,CUS]; Li et al. (2009)[INT+EXT]; Braunscheidel et al. (2010)[SUP]; Flynn et al. (2010)[INT,SUP,CUS]; Kannan and Tan (2010)[CUS]; Boon-itt and Wong (2011)[INT,SUP,CUS]; Wong et al. (2011)[INT,SUP,CUS]; Huo (2012)[INT,SUP,CUS]; Gimenez et al. (2012)[CUS] ; Prajogo and Olhager (2012)[SUP]; van der Vaart et al. (2012)[CUS]; Kim et al. (2013)[EXT]; Wong et al. (2013)[INT,EXT]; Adams et al. (2014)[INT]; Seo et al. (2014)[INT,SUP,CUS]; Caniato and Größler (2015)[SUP]; Wong et al. (2015a)[EXT]; Kauppi et al. (2016)[INT,SUP,CUS]; Lii and Kuo (2016)[INT,SUP,CUS]; Moyano-Fuentes et al. (2016)[INT,EXT]; Turkulainen and Swink (2017)[INT] ; Wong et al. (2017b)[INT,SUP,CUS]; Chaudhuri et al. (2018)[EXT]; Ebrahimi et al. (2018)[INT,SUP,CUS]; Kumar et al. (2018)[EXT]; Bruque-Càmara et al. (2016)[EXT]
INF	Ragatz et al. (2002)[SUP]; Koufteros et al. (2005)[INT]; Liao et al. (2017)[INT+EXT]; Kim and Schoenherr (2018)[INT]	Dong et al. (2001)[SUP]; Frohlich and Westbrook (2001)[SUP,CUS]; Salvador et al. (2001)[SUP,CUS]; Fynes et al. (2004)[CUS]; Swink et al. (2005)[SUP]; Das et al. (2006)[SUP]; Kim (2006)[INT,SUP,CUS]; Vereecke and Muylle (2006)[SUP,CUS]; Ward and Zhou (2006)[CUS]; Carr and Kaynak (2007)[INT,SUP]; Devaraj et al. (2007)[CUS,SUP]; Sanders (2007)[INT,SUP]; Quesada et al. (2008)[SUP,CUS]; Kim (2009)[INT,SUP,CUS]; Braunscheidel et al. (2010)[SUP,CUS]; Cao et al. (2010)[EXT]; Flynn et al. (2010)[INT,SUP,CUS]; Kannan and Tan (2010)[SUP,CUS]; Boon-itt and Wong (2011)[INT,SUP,CUS]; Cao and Zhang (2011)[EXT]; Danese and Romano (2011a)[SUP,CUS]; Wong et al. (2011)[INT,SUP,CUS]; Gimenez et al. (2012)[CUS]; Huo (2012)[INT,SUP,CUS]; Prajogo and Olhager (2012)[SUP]; Schoenherr and Swink (2012)[INT,SUP]; Van der Vaart et al. (2012)[CUS] ; Baihaqi and Sohal (2013)[SUP,CUS]; Danese and Romano (2013)[CUS]; Danese (2013)[SUP]; Liu et al. (2013)[EXT]; Wiengarten et al. (2013)[SUP]; Williams et al. (2013)[INT]; Wong et al. (2013)[INT,EXT]; Adams et al. (2014)[INT,EXT]; Seo et al. (2014)[INT,SUP,CUS]; Wiengarten et al. (2014)[SUP,CUS]; Wu et al. (2014)[EXT]; Chavez et al. (2015)[CUS]; Swink and Schoenherr (2015)[INT]; Srinivasan and Swink (2015)[INT,SUP]; von Haartman and Bengtsson (2015)[SUP]; Wong et al. (2015a)[EXT]; Huo et al. (2016)[INT,SUP,CUS]; Kauppi et al. (2016)[INT,SUP,CUS]; Lii and Kuo (2016)[INT,SUP,CUS]; Moyano-Fuentes et al. (2016)[INT,EXT]; Wiengarten et al. (2016)[SUP,CUS]; Liao et al. (2017)[INT+EXT]; Pradabwong et al. (2017)[EXT]; Turkulainen and Swink (2017)[SUP]; Vanpoucke et al. (2017)[EXT]; Wong et al. (2017a)[INT,SUP,CUS]; Wong et al. (2017b)[INT,SUP,CUS]; Chaudhuri et al. (2018)[INT,EXT]; Ebrahimi et al. (2018)[INT,SUP,CUS]; Kumar et al. (2018)[EXT]; Jajja et al. (2018)[INT,SUP,CUS]; Shou et al. (2018)[SUP,CUS]; Shee et al. (2018)[SUP]; Kim and Schoenherr (2018)[INT,SUP,CUS]; Michalski et al. (2018)[EXT]; Bruque-Càmara et al. (2016)[EXT]

Table 4.3 (continued)

	NPD	LOG
COL	Ragatz et al. (2002)[SUP]; Droge et al. (2004)[INT]; Fynes et al. (2004)[CUS]; Koufteros et al. (2005)[INT,SUP,CUS]; Swink et al. (2005)[INT]; Koufteros et al. (2005)[SUP,CUS]; Kim (2006)[SUP]; Swink and Nair (2007)[INT]; Kim (2009)[SUP]; Mckone-Sweet and Lee (2009)[CUS]; Mishra and Shah (2009)[INT,SUP,CUS]; Braunscheidel et al. (2010)[SUP,CUS]; Cao et al. (2010)[EXT]; Flynn et al. (2010)[INT,SUP]; Kannan and Tan (2010)[SUP]; Koufteros et al. (2010)[INT,SUP,CUS]; Boon-itt and Wong (2011)[SUP,CUS]; Cao and Zhang (2011)[EXT]; Wong et al. (2011)[SUP,CUS]; Huo (2012)[INT,SUP]; Baihaqi and Sohal (2013)[SUP]; Liu et al. (2013)[EXT]; Wiengarten et al. (2013)[SUP]; Danese and Bortolotti (2014)[CUS]; Seo et al. (2014)[SUP,CUS]; Wu et al. (2014)[EXT]; Caniato and Größler (2015)[INT]; Huo et al. (2016)[INT,SUP,CUS]; Lii and Kuo (2016)[INT,SUP]; Liao et al. (2017)[INT+EXT]; Turkulainen and Swink (2017)[INT]; Wong et al. (2017b)[SUP,CUS]; Ebrahimi et al. (2018)[INT,SUP]; Kim and Schoenherr (2018)[INT,SUP,CUS]	Salvador et al. (2001)[INT]; Vickery et al. (2003)[INT+EXT]; Droge et al. (2004)[INT,EXT]; Fynes et al. (2004)[CUS]; Das et al. (2006)[SUP]; Kim (2006)[INT,SUP]; Vereecke and Muylle (2006)[SUP,CUS]; Carr and Kaynak (2007)[SUP]; Devaraj et al. (2007)[CUS,SUP] Jacobs et al. (2007)[SUP]; Sanders (2007)[INT,SUP]; Germain et al. (2008)[INT]; Quesada et al. (2008)[CUS]; Li et al. (2009)[INT+EXT]; Mckone-Sweet and Lee (2009)[SUP,CUS]; Braunscheidel et al. (2010)[INT]; Cao et al. (2010)[EXT]; Flynn et al. (2010)[INT,SUP]; Kannan and Tan (2010)[EXT]; Boon-itt and Wong (2011)[SUP,CUS]; Cao and Zhang (2011)[EXT]; Danese and Romano (2011a)[SUP,CUS]; Danese and Romano (2011b)[CUS]; Cao and Zhang (2011)[EXT]; Wong et al. (2011)[SUP,CUS]; Droge et al. (2012)[SUP,CUS]; Gimenez et al. (2012)[CUS]; Huo (2012)[INT,SUP]; Koufteros et al. (2012)[SUP]; Liu et al. (2012)[INT]; Schoenherr and Swink (2012)[INT,SUP,CUS]; Springinklee and Wallenburg (2012)[INT]; Van der Vaart et al. (2012)[CUS]; Baihaqi and Sohal (2013)[SUP,CUS]; Danese and Romano (2013)[CUS]; Danese (2013)[SUP]; Danese et al. (2013)[INT,EXT]; Kim et al. (2013)[EXT]; Liu et al. (2013)[EXT]; Wiengarten et al. (2013)[SUP]; Williams et al. (2013)[INT]; Wong et al. (2013)[EXT]; Adams et al. (2014)[EXT]; Blome et al. (2014)[SUP,CUS]; Danese and Bortolotti (2014)[INT,SUP,CUS]; Seo et al. (2014)[SUP,CUS]; Wiengarten et al. (2014)[SUP,CUS]; Wu et al. (2014)[EXT]; Alfalla-Luque et al. (2015)[INT,SUP,CUS,EXTO]; Caniato and Größler (2015)[SUP]; Chavez et al. (2015)[CUS]; Srinivasan and Swink (2015)[INT,SUP,CUS]; Swink and Schoenherr (2015)[INT]; von Haartman and Bengtsson (2015)[SUP]; Huo et al. (2016)[INT,SUP,CUS]; Kauppi et al. (2016)[INT,SUP,CUS]; Lii and Kuo (2016)[INT,SUP]; Moyano-Fuentes et al. (2016)[INT,EXT]; Prajogo et al. (2016)[SUP]; Wiengarten et al. (2016)[SUP,CUS]; Dai et al. (2017)[SUP]; Pradabwong et al. (2017)[EXT]; Turkulainen and Swink (2017)[SUP]; Vanpoucke et al. (2017)[EXT]; Wong et al. (2017a)[INT,SUP,CUS]; Wong et al. (2017b)[SUP,CUS]; Chaudhuri et al. (2018)[INT,EXT]; Ebrahimi et al. (2018)[INT,SUP]; Kumar et al. (2018)[EXT]; Sáenz et al. (2018)[SUP]; Zhu et al. (2018)[EXT]; Jajja et al. (2018)[INT,SUP,CUS]; Shou et al. (2018)[SUP,CUS]; Shee et al. (2018)[INT,SUP,CUS]; Michalski et al. (2018)[EXT]; Bruque-Càmara et al. (2016)[EXT]

Note: NPD = new product development, LOG = integrated logistics, TECH = technological integration, INF = information sharing, COL = general collaboration
INT = internal integration, SUP = integration with suppliers, CUS = integration with customers, EXT = external integration (without distinguishing between upstream and downstream integration), INT+EXT = supply chain integration (without distinguishing between internal and external integration)

While some papers focus only on internal integration or on integration with customers or suppliers, other studies adopt a broader perspective, with a single construct to measure external integration (both upstream and downstream) or supply chain integration globally (i.e. without distinguishing between the possible directions of integration). Differences are not limited to the direction of integration. Some authors consider integration in terms of information sharing, others as technological links and alignment (e.g., enterprise application integration, integrated systems), while many others focus on collaborative aspects such as cooperation and teamwork in carrying out activities and tasks. In addition, these forms of SCI are applied to different processes, primarily new product development (NPD) and integrated logistics (e.g., production planning, inventory management, etc.). By combining the three mentioned SCI conceptualizations (coded as information sharing, technological integration, and general collaboration) and the two processes (NPD and integrated logistics), Table 4.3 synthesizes the variety of SCI measures emerging from the SLR. From the table, it is evident that most papers deal with general collaboration and information sharing in integrated logistics.

In regard to country and industry settings, the SLR indicates that almost half of the papers are focused on single countries, typically the US (e.g., Koufteros et al., 2012) and China (e.g., Flynn et al., 2010); furthermore, most of them are multi-industry and only few studies focus on specific sectors, among which the automotive industry has a dominant representation (e.g., Droge et al., 2004).

We also analyzed the statistical methods used by the authors to test Venkatraman's (1989) fit types. Table 4.4 shows that Structural Equation Modelling (SEM) is the most used methodology among all the studies and that it is particularly common in testing the mediation hypotheses. Regression analysis is instead prevalent in studying moderation, while cluster analysis and Analysis of Variance (ANOVA) are commonly adopted in investigating fit as gestalts.

Table 4.4 Statistical methods to test Venkatraman's fit types.

	SEM	**Regres-sion**	**Cluster analysis + t-test**	**Cluster analysis + ANOVA**	**Cluster analysis + ANCOVA**	**ANC-OVA**	
Mediation	34	4					38
Moderation	13	22				1	36
Mediation and moderation	7	1					8
Gestalts			2	7	1		10
Profile deviation	2	1					3
Covariation	6						6
	62	28	2	7	1	1	101*

**Note: Some papers apply more than one fit type*

In terms of theoretical lenses, we found that almost 65% of the papers are grounded in consolidated management theories and many of them refer to more than one theoretical perspective (Table 4.5). A wide variety of theories (28) has been used by the authors in order to clarify how and why a certain factor or practice is assumed to "fit" with SCI, influencing performance. Although the choices are different according to the specific purpose of the study, it is possible to isolate three major theories (Table 4.6).

Table 4.5 Supporting theories used in the reviewed papers

Fit type	Supporting theory/theories
Fit as mediation	Adaptive Structuration Theory (Droge et al., 2012) Organisational capability (Huo, 2012) Organizational theory (Koufteros et al., 2005) RBV (Koufteros et al., 2012; Springinklee and Wallenburg, 2012; Alfalla-Luque et al., 2015; Huo et al., 2016) RBV + Dynamic capabilities theory (Moyano-Fuentes et al., 2016; Jajja et al., 2018) RBV + OIPT (Liu et al., 2012) RBV + Relational view + Theory of swift and even flow (Devaraj et al., 2007) RBV + Relationship marketing literature (Kim et al., 2013) RBV + Value chain analysis framework (Prajogo et al. 2016) RBV + Firm and strategy-structure-performance framework (Dai et al., 2017) RBV + Knowledge management perspective + SCT (Bruque-Càmara et al., 2016) Resource dependence theory (Lii and Kuo, 2016) Resource advantage theory (Adams et al., 2014) SCT (Chavez et al., 2015) Social exchange theory (Wu et al., 2014) TCE (Vickery et al., 2003; Sanders 2007; Li et al., 2009) Contingency theory (Ebrahimi et al., 2018)
Fit as moderation	CT (Koufteros et al., 2005; Germain et al., 2008; Flynn et al., 2010; van der Vaart et al., 2012; Danese 2013; Danese and Romano, 2013; Danese et al., 2013; Turkulainen and Swink, 2017) CT + OIPT (Wong et al., 2011) CT + System theory (Michalsky et al., 2018) Information processing theory (Schoenerr and Swink, 2012) OIPT (Williams et al., 2013; Swink and Schoenherr, 2015; Wong et al., 2015a; Shou et al., 2018) OIPT + Relational view theory + Ambidextery theory (Wong et al., 2013) OIPT + TCE (Kim and Schoenherr, 2018) RBV (Liu et al., 2013; Shu et al., 2018) RBV + Contingency theory (Wong et al., 2017a) Relational view (Devaraj et al., 2007; Wiengarten et al., 2016) Resource advantage theory (Adams et al., 2014) Transaction cost theory + Political-economy perspective + Economic sociology + Social exchange theory + Resource dependent theory (Fynes et al., 2004) Agency theory (Chaudhuri et al., 2018)
Joint mediation and moderation	RBV (Kim, 2009) OIPT (Srinivasan and Swink, 2015; Wong et al., 2015b) TCE + RBV + relational view (Cao and Zhang, 2011; Zhu et al., 2018) Resource advantage theory (Adams et al., 2014)

Table 4.5 (continued)

Fit type	Supporting theory/theories
Fit as gestalts	Configurational theory (Flynn et al., 2010; Danese and Bortolotti, 2014) RBV (Schoenerr and Swink, 2012) RBV + Configurational theory (Mckone-Sweet and Lee, 2009; Wong Et al., 2017b) OIPT + Complementarity theory (Kauppi et al., 2016)
Fit as profile deviation	RBV + Transaction cost theory + Institutional isomorphism theory (Das et al., 2006) Knowledge-based view + Relational view (Blome et al., 2014)
Fit as covariation	RBV + Complementarity theory (Mishra and Shah, 2009) TCE + RBV + relational view (Cao and Zhang, 2011) TCE + RBV + Uncertainty reduction perspective + learning and knowledge perspective (Cao et al., 2010)

Note: RBV = Resource based view, OIPT = Organizational Information Processing Theory, SCT = Social Capital Theory, TCE = Transaction Cost Economics, CT = Contingency theory/approach

Table 4.6 The three most used theories

Theory	N. of papers	Details on the use of theory
Resource Based View (RBV): A firm's performance depends on its unique resources and capabilities that are hard to imitate (Barney, 1991)	24	RBV-based papers apply five fit forms (mediation, moderation, gestalts, profile deviation, covariation). The general assumption is that SCI can be seen as a valuable resource difficult to imitate. In this sense, research models studied significantly differ.
Contingency Theory (CT): It suggests that a firm's environment shapes its structure and processes (Flynn et al., 2010)	12	Papers applying fit as moderation extensively rely on CT.
Organisational Information Processing Theory (OIPT): It highlights the need to improve information process capability to remain competitive in uncertain business environments (Lawrence and Lorsch, 1967; Thompson, 1967)	11	Almost all papers (except one) which apply OIPT rely on fit as moderation. The general idea is that information processing capabilities may be enhanced by coordinating activities, sharing information or developing appropriate IT platforms with supply chain partners. OIPT is used to hypothesize that SCI improves performance in particular environments (e.g. usually the complex ones), where information processing capabilities are crucial.

4.3.2 Classification of papers selected based on Venkatraman's framework

This SLR classifies and analyzes the articles reported in Table 4.2 based on Venkatraman's (1989) framework. It reveals that mediation (n=38) and moderation (n=36) are the most used forms of fit, while matching has never been applied to SCI; fit as gestalts (n=10) has been moderately investigated, and covariation (n=6) and profile deviation (n=3) have an even narrower application. We must underline that some papers are included in more than one group, since authors sometimes apply two different fits in the same research (e.g., Devaraj et al., 2007; Flynn et al., 2010). In eight papers, the authors combine fit as mediation and as moderation in the same analysis.

In the following sections, we examine and compare the papers selected, grouped by the forms of fit used.

4.3.2.1 Mediation

The papers using this perspective can be divided into two major groups based on the specific role integration practices play in the fit model. In the first group, they are antecedents of other practices and thus authors try to identify those factors that mediate SCI impact on performance. The second group of studies instead analyze the antecedents of SCI.

Mediators of the relationship between SCI and performance

There are 25 papers dealing with the mediators of the integration-performance relationship (Table 4.7).

Table 4.7 Papers dealing with mediators of the relationship between SCI and performance

Mediators		Link investigated
Operational practices as mediators of the effect of other SCI practices	Lean/JIT adoption	Supply chain integration - Logistics cost (Dong et al., 2001); Within and between IT integration - Lead time reduction (Ward and Zhou, 2006); Supply logistics integration - Competitive performance (Prajogo et al., 2016)
	Mass customization	Functional integration - Operational performance (Liu et al., 2012)
	Green process innovation	Green collaboration with suppliers - Operational performance (Dai et al., 2017)
SCI practices as mediators of the effect of other SCI practices	Interorganizational learning	Buyer-supplier collaboration - Flexibility (Sáenz et al., 2018)
	External integration orientation	Customer integration - Operational performance; Supplier integration - Operational performance (Alfalla-Luque et al., 2015)
	Information quality	Customer integration - Operational performance (Chavez et al., 2015)
	Information sharing between firms	Traditional communication methods - Product quality improvement and financial performance (Carr and Kaynak, 2007)
	Logistics integration	Information integration - Operational performance (Prajogo and Olhager, 2012)
	External collaboration	Information sharing - Operational and financial performance (Baihaqi and Sohal, 2013; Wu et al., 2014)

Table 4.7 (continued)

Mediators		Link investigated
SCI practices as mediators of the effect of technological integration practices	Supplier integration and customer integration	eBusiness capability - Operational performance (Devaraj et al., 2007); Internal integration – Agility performance (Jajja et al., 2018)
	Inter- and intra-organizational collaboration	e-business technologies - Operational performance (Sanders, 2007)
	Buyer-supplier collaboration	e-business applications - Operational performance (Wiengarten et al., 2013)
	Supply chain integration	Integrative information technology - Customer service (Vickery et al., 2013)
	Internal and external integration	Advanced Manufacturing Technology - Responsiveness (Moyano-Fuentes et al., 2016)
	Supply chain integration	IT implementation - Operational performance (Li et al., 2009)
	Physical and informational flow integration	Community cloud computing – Operational performance (Bruque-Càmara et al., 2016)
Link between internal and external integration practices	Internal practices for control and coordination	Interactions with suppliers and customers for flow - Quality management (Punctuality of delivery and operations speed) (Salvador et al., 2001)
	Information sharing between firms and supplier development support	Information sharing within a firm - Product quality improvement and financial performance (Carr and Kaynak, 2007)
	External integration	Internal integration - Product innovation, quality and profitability (Koufteros et al., 2005); Internal integration - Operational performance (Alfalla-Luque et al., 2015)
	Customer integration	Internal integration - Customer-oriented performance (Huo, 2012)
	Supplier integration	Internal integration - Supplier-oriented performance (Huo, 2012)
	Intra-organizational collaboration	Inter-organizational collaboration - Operational performance (Sanders, 2007)

In several cases, the mediators are different operational practices; for instance lean/JIT. A basic assumption here is that integration practices represent the foundation for building more specific practices. For instance, they facilitate lean/JIT by helping avoid the fragility inherent in several lean/JIT production systems.

In the remaining papers (the majority), antecedents and mediators are different types of integration practices. Several papers focus on technological integration as a prerequisite of other integration practices. Another frequently studied link is the one between internal and external integration. Most authors conclude that the former acts as an antecedent of the latter, which in turn improves operational performance. The fact that this argument has been widely investigated over time reflects the shared view that the decisions a firm makes about internal and external integration are usually strictly connected and concerted, and that a company follows a well-defined path towards full integration starting from integration within the company's boundaries. Overall, studies summarized in Table 4.7 shed some light on the link between SCI and performance, helping to explain the underlying mechanisms of this relationship.

Antecedents of the relationship between SCI and performance

In this group (n=19), SCI is the mediator between an antecedent variable and performance. Comparing papers, we placed them into three main groups:
human capital characteristics, where the antecedent variable considers aspects such as knowledge, skills and, in general, managers' and employees' characteristics;
company characteristics, where antecedents are expressed at the corporate level and refer to some general characteristics of a company;
supplier network characteristics, where the antecedents are external to the company and linked to the characteristics of the supplier network.
Table 4.8 summarizes the results found for each group of antecedents. One paper (Jajja et al., 2018) was included into two groups because the proposed antecedent, supply chain risk, refers to characteristics related both to the company (i.e. manufacturing disruption risk) and to its supplier network (i.e. supply disruption risk).
An important conclusion of this overview is that papers dealing with antecedents of the SCI-performance relationship represent a fairly studied research stream, when considering both integration in NPD and integrated logistics. However, within this research field, it appears evident that an interesting research area with many potentialities is that of the role of human capital characteristics, which certainly deserves special attention in future research studies (see section 4.4.1.1).

Table 4.8 Papers dealing with the antecedents of the relationship between SCI and performance

Subgroup	Antecedent	Link investigated
Human capital characteristics (n=3)	Commitment	Internal, supplier and customer integration - Flexibility, inventory, quality and customer satisfaction (Alfalla-Luque et al., 2015); Internal and customer integration - Competitive performance (Huo et al., 2016);
	Multiskilling	Internal and customer integration - Competitive performance (Huo et al., 2016)
	Heavyweight product development managers	Internal integration - Glitches, on-time execution of engineering change orders and market success (Koufteros et al., 2010)

Table 4.8 (continued)

Subgroup	Antecedent	Link investigated
Company characteristics (n=12)	Adhocracy, hierarchical, clan and market culture	Internal and external integration - Delivery (Braunscheidel et al., 2010)
	Organizational structure	Internal, supplier and customer integration - Operational performance (Ebrahimi et al., 2018)
	Innovativeness	Internal, supplier and customer integration - Operational performance (Seo et al., 2014)
	Innovation orientation	Internal and supplier integration - Business performance and combinative competitive capabilities (Lii and Kuo, 2016)
	Corporate environmental proactive strategy	Green supplier integration - Operational performance (Dai et al., 2017)
	Product modularity	Supplier, design and manufacturing integration - Cost, quality, cycle time and flexibility (Jacobs et al., 2007); Supplier and customer integration - Delivery and support performance (Droge et al., 2012)
	Process modularity	Customer and supplier integration - Delivery and support performance (Droge et al., 2012)
	Technology complexity	Supplier integration - Cost, quality and cycle time (Ragatz et al., 2002)
	Cooperative behavior	Planning information - Operational performance (van der Vaart et al., 2012)
	Business process management	Supply chain collaboration - Organizational performance (Pradabwong et al., 2017)
	Working relationships effectiveness	Production and logistics integration - Distribution service performance (Springinklee and Wallenburg, 2012)
	Supply chain risk	Internal, supplier and customer integration – Agility performance (Jajja et al., 2018)
Supplier network characteristics (n=5)	Long-term relationships	Information and logistics integration - Operational performance (Prajogo and Olhager, 2012)
	Strategic supplier selection	Supplier partnership and supplier development - Competitive performance capabilities (Koufteros et al., 2012)
	Strategic importance of supply chain partners	IT alignment and strategic collaboration - Responsiveness (Kim et al., 2013)
	Trust, commitment, reciprocity and power	Information sharing and collaboration - Operational and financial performance (Wu et al., 2014)
	Supply chain risk	Internal, supplier and customer integration – Agility performance (Jajja et al., 2018)

Note: One paper (Jajja et al., 2018) belongs to two sub-groups

4.3.2.2 Moderation

Based on the nature of the moderating factors, we classified these papers into two groups, labelled "integration-based" or "context-based." The former moderators represent various integration practices, whereas the latter ones concern environmental factors characterizing the context.

Integration-based moderators

There are 14 papers applying an integration-based moderator. Table 4.9 provides an overview of the interactions analyzed by these papers.

Table 4.9 Papers dealing with integration-based moderators

Analyzed interactions	Performance
(Internal integration) x (Supplier integration)	Operational and financial performance (Flynn et al., 2010)
(Internal integration) x (Customer integration)	Operational and financial performance (Flynn et al., 2010)
(Internal integration) x (Supplier integration) x (Customer integration)	Operational and financial performance (Flynn et al., 2010)
(Internal integration) x (External integration)	Financial performance (Droge et al., 2004); Delivery, quality, cost and flexibility (Schoenherr and Swink, 2012); Product innovation (Wong et al., 2013)
(Supplier integration) x (Customer integration)	Operational performance (Devaraj et al., 2007; Flynn et al., 2010); Financial performance (Flynn et al., 2010); Efficiency (Danese and Romano, 2011a)
(Integration) x (Collaboration)	Firm performance and logistic service competency (Adams et al., 2014)
(Involvement of supply chain personnel in innovation activities) x (Supplier integration)	Cost, delivery and flexibility (Turkulainen and Swink, 2017)
(Cross-functional integration) x (Customer product and process integration), (Cross-functional integration) x (Supplier product and process integration)	Return on contract manufacturing (Kim and Schoenherr, 2018)
(Internal integration) x (Demand visibility), (Internal integration) x (Supply visibility), (Internal integration) x (Market visibility)	Responsiveness (Williams et al., 2013)
(Design-Manufacturing Integration) x (Advanced manufacturing planning and process technologies)	Process flexibility, cost efficiency, delivery, quality and new product flexibility (Swink and Nair, 2007)
(Customer integration) x (Supply network performance measurement systems)	Efficiency (Danese and Romano, 2011b)
(Strategy integration) x (Manufacturing practices)	Manufacturing capabilities (Swink et al., 2005)
(Asymmetry) x (Collaboration), (Asymmetry) x (Integration)	Financial performance (Michalsky et al. 2018)

As it can be seen from the table, in nine of them, both moderators and predictors are dimensions of SCI, most of which are classified by the authors based on the scope of the integration as internal, external, customer, or supplier. In the remaining five papers (Swink et al., 2005; Swink and Nair, 2007; Danese and Romano, 2011b; Williams et al., 2013; Michalsky et al. 2018), the fit is between a dimension of SCI and other practices, which in some cases are strictly linked to integration, such as demand visibility (Williams et al., 2013) and supply network performance measurement systems (Danese and Romano, 2011b). It is apparent that the interaction between internal and external (or customer/supplier) integration has been widely investigated. Studies agree that these practices have a synergic effect on performance. A common argument is that the benefits of integrating with external partners can be lost if a company is not integrated internally, as inefficiencies can occur which may undermine any potential improvement.

Context-based moderators

We split the 23 papers in this category into two groups, depending on whether the moderators are country- or firm and supply network-related (Table 4.10).

Table 4.10 Papers dealing with context-based moderators

Group	Sub-group	Moderator	Links investigated
Country-related moderator (n=3)	-	Country's logistical capabilities	Customer integration - Operational performance (Wiengarten et al., 2014)
		Country's rule of law	Supplier and customer integration - Cost and innovation (Wiengarten et al., 2016)
		National culture	Internal, customer and supplier integration - Operational performance (Wong et al., 2017a)
Firm and supply network related moderator (n=20)	Uncertainty (n=5)	Uncertainty (unique construct)	Supplier and customer integration - Product innovation and quality (Koufteros et al., 2005); Internal, supplier and customer integration - Cost, delivery, flexibility and quality (Wong et al., 2011)
		Technological uncertainty	Internal, supplier and customer integration – Delivery (Boon-itt and Wong, 2011); Supply chain relationship quality - Operational performance (Fynes et al., 2004)
		Demand uncertainty (or unpredictability)	Internal, supplier and customer integration – Delivery (Boon-itt and Wong, 2011); Supply chain relationship quality - Operational performance (Fynes et al., 2004); Cross-functional integration - Financial performance (Germain et al., 2008)
		Supply uncertainty	Supply chain relationship quality - Operational performance (Fynes et al., 2004)

Table 4.10 (continued)

Group	Sub-group	Moderator	Links investigated
Firm and supply network-related moderator (n=20)	Complexity (n=4)	Supply complexity	Customer integration - Cost and service performance (Gimenez et al., 2012); Planning information and joint improvement - Performance (van der Vaart et al., 2012)
		Product complexity	Supply chain integration and new product development integration - Innovation and flexibility (Caniato and Größler, 2015)
		Product and market complexity	Supply chain information integration - Operational performance (Wong et al., 2015a)
	Network structure (n=4)	Fast supply network structure	Customer integration - Efficiency (Danese and Romano, 2013); Supplier integration – Efficiency, schedule attainment and flexibility (Danese, 2013)
		Use of an international supplier network	Internal and external integration - Responsiveness (Danese et al., 2013)
		Global purchasing	Supplier integration – Product innovation and time to market (von Haartman and Bengtsson, 2015)
	Others (n=8)	Equivocality and platform strategy	Internal, customer and supplier integration - Product innovation and quality (Koufteros et al., 2005)
		Customer and competitor orientation	Information sharing and operational coordination - Operational and business performance. (Liu et al., 2013)
		Span of supply chain processes	Internal integration - Return on Assets, Return on Sales and Assets Turnover (Swink and Schoenherr, 2015)
		Supply chain echelon	Supply chain collaboration value innovation - Supply chain capabilities and competitive advantage (Liao et al., 2017)
		Industry technological context	Involvement of supply chain personnel in innovation activities - Cost (Turkulanien and Swink, 2017)
		Supply chain risk management practices	Internal and external integration – Flexibility (Chaudhuri et al., 2018)
		Internal production system	Supplier and customer integration – Operational performance (Shou et al., 2018)
		Top management support for cloud technology adoption	Internal, supplier and customer integration – Supply chain performance (Shee et al., 2018)

Note: One paper (Koufteros et al., 2005) belongs to two sub-groups

From Table 4.10, some interesting conclusions can be drawn.

An important point of evidence is that, although country-related factors can have significant implications in terms of SCI effectiveness, this issue remains under-investigated in quantitative studies on the fit between context, SCI, and performance.

Secondly, as regards the role of complexity and uncertainty as moderators, we note that this represents a very rich field of research. However, results found are different depending on the integration practices and the type of complexity or uncertainty considered. Complexity can be distinguished into supply, product, and market complexity. Supply complexity (Gimenez et al., 2012; van der Vaart et al. 2012) refers to the complexity of the process through which buyers' orders are converted into the supplier's manufacturing orders and are measured considering batch size, lead time, and order winning criteria, etc. Product complexity (Caniato and Größler, 2015; Wong et al., 2015a) is instead linked to the nature of product development, namely the number of different organizations involved, the diversity of inputs received from the suppliers, and the frequency of changes in suppliers' actions. Market complexity (Wong et al., 2015a) measures the different types of customers served, different types of products distributed, and frequency of changes in the way of marketing products. Regarding uncertainty, previous studies are also very heterogeneous in the focus and measures adopted. Some authors consider different typologies of uncertainty (e.g. demand, supply, and technological), while others use a single construct that comprises these different aspects. Demand uncertainty measures the fluctuation of demand in terms of requirements, orders, or dates; supply uncertainty considers the tendency of the suppliers to meet requirements and guarantee quality; technological uncertainty reflects the speed of technological changes and its importance in the company's sector. In many papers (e.g., Fynes et al., 2004; Wong et al., 2011; Gimenez et al., 2012), the main rationale is that SCI is more beneficial in situations of high complexity and uncertainty. However, findings vary significantly depending on the type of complexity and uncertainty considered. This suggests the need to adopt a fine-grained perspective that distinguishes between different types of uncertainty/complexity, integration, and performance, as the results can differ (see section 4.4.1.2).

Finally, referring to the factors related to the network structure, we observe that they are usually linked to supplier lead times and supplier network internationalization. Many other factors that may influence the SCI-performance link have not yet been quantitatively studied, for example, the level of specialization of the production network (Dornier, 1998), the length and fragmentation of the supplier network, or the use of international second-tier suppliers, to mention just a few.

4.3.2.3 Mediation and moderation

We found eight papers simultaneously addressing fit as mediation and moderation. In seven cases, the authors split the sample into two groups, according to the value of the moderator, and then test a mediation hypothesis in both groups (see Table 4.11). The remaining paper (Adams et al.,

2014) verifies if the effect of the joint implementation of different integration practices (labelled integration and collaboration) on performance is transmitted through a mediation variable (relational technology competency).

Table 4.11 Papers testing mediation hypotheses in different groups

Moderator	Mediator	Link investigated
Firm size	Collaborative advantage	Supply chain collaboration - Financial performance (Cao and Zhang, 2011)
	Competition capabilities and other practices	Supply chain integration - Financial performance (Kim 2006; Kim 2009)
Technology-enabled SCM systems	Planning comprehensiveness	Internal, customer and supplier integration - Operational performance (Srinivasan and Swink, 2015)
IT infrastructure development	IT-enabled collaborative decision-making	Inter-organizational information integration - Customer service (Wong et al., 2015b)
IT use	Operational integration	Information exchange – Operational performance (Vanpoucke et al., 2017)
Focal firm power	Supply chain learning	Supply chain integration - Customer service and innovation (Zhu et al., 2018)

We believe that these models, in which two different fit types are simultaneously applied in the same research, have huge potential in SCI literature, particularly in explaining *how* and *when* integration affects performance. For instance, according to Hayes (2013), by combining mediation and moderation in the same model, it is possible to provide a richer and more powerful explanation of the phenomenon and, most of all, to avoid the oversimplifications that a separated analysis may imply (e.g., a mediation analysis that ignores important contingencies). However, despite these potential benefits, and unlike other research fields such as sociology (e.g., Rego et al., 2017) or medicine (e.g., Schimmenti et al., 2017), such analyses and models are not common in the SCI area. This evidence provided us with some interesting ideas for future research, as reported in the section 4.4.2.1.

4.3.2.4 Gestalts

These papers identify groups of companies with similar forms and levels of SCI and investigate whether some groups are characterized by superior performance. Some authors consider only external integration (e.g., Frohlich and Westbrook, 2001; Vereecke and Muylle, 2006; Quesada et al., 2008; Schoenherr and Swink, 2012), while others also include internal integration (e.g., Flynn et al., 2010; Danese and Bortolotti, 2014; Wong et al, 2017b). One paper (Mckone-Sweet and Lee, 2009) combines the use of internal and external integration with the use of IT capabilities and demonstrates that when both these aspects are developed, firms reach higher levels of quality, delivery, and flexibility. Finally, Kauppi et al. (2016) consider the combination of external integration and risk management, finding that the group with the greater levels of both practices has higher values of quality, flexibility, cost, and customer service.

In general, all authors support the idea that companies extensively adopting SCI have a superior performance. According to Kannan and Tan (2010), the span of SCI, namely the integration going beyond immediate partners, also has a positive impact on performance.

However, studies point out some differences in terms of benefits according to the direction of integration (i.e., upstream or downstream). For example, some authors (Flynn et al., 2010; Danese and Bortolotti, 2014) find that firms with high levels of internal and customer integration have a similar performance to the highly integrated ones (with high levels of internal, customer, and supplier integration) and underline that this performance is significantly better than that of all the other groups. Therefore, they conclude that it is better to focus investments on few SCI dimensions rather than investing moderately in all dimensions. Conversely, Frohlich and Westbrook (2001) and Schoenherr and Swink (2012), using the concept of "arcs of integration," conclude that if companies concentrate their investments on customer or supplier integration only, they do not obtain better advantages than companies with low integration levels. Finally, Quesada et al. (2008) find that companies with high levels of supplier integration offer better customer service than companies integrating only with customers. Thus, they suggest a strong investment in upstream integration to those companies looking for customer service improvement.

A general conclusion is that most papers dealing with fit as gestalts try to understand when and why a balanced upstream and downstream integration is advisable, or whether and when it is more appropriate to focus on upstream or downstream integration; but results are not unanimous. This may have been caused by differences in the cluster definition, since not all studies include both internal and external integration. However, further research is certainly needed to deepen and extend the knowledge on the issue (see section 4.4.1.3).

4.3.2.5 Profile deviation

We found only three papers applying the concept of fit as profile deviation in the context of integration: Das et al. (2006), Blome et al. (2014), and Kumar et al. (2018). The first study identifies an optimal profile in terms of integration with suppliers. This is obtained by selecting the top 10% performing firms and calculating the mean score of their core supplier integration practices. This result represents the "ideal profile" of supplier integration. At this point, deviations from the optimal profile can be measured considering a weighted difference between a firm's integration practices scores and the mean scores of the ideal profile. Following this procedure, Das et al. (2006) show that both positive and negative deviations from the optimal profile of supplier integration have a negative impact on performance. The conclusion is that there is a curvilinear relationship between supplier integration and performance. Therefore, investing in supplier integration is beneficial only up to a certain level and, once this level is reached, there is no benefit to continue investing in such practices, as performance will not further improve. The same procedure is applied by the other two papers. Blome et al. (2014) develop an ideal profile of demand- and supply-side sustainability collaboration and find that a deviation from this profile has a negative impact on sustainability and market performance, but only through the mediation of sustainable production. Kumar et al. (2018) show instead that a misalignment from the ideal profiles of "joint planning and resource sharing" and "collaborative culture" has a negative effect on operational, environmental, and social performance through the mediation of dynamic capabilities.

The use of a profile deviation analysis is noteworthy because it suggests a different and complementary approach to studying the integration-performance relationship. Unlike the other fit forms, it does not suppose that the relationships between the variables is linear and thus encourages researchers to consider the complexity of the dynamics that can occur in the SCI-performance link. Despite this, the application of profile deviation in the SCI field remains limited to only three studies. This opens several lines of future research (see section 4.4.1.4).

4.3.2.6 Covariation

These papers all define second-order factors that represent the coalignment between a set of measures (first-order factors) and analyze their impact on performance. Till now, five different second-order factors have been developed in the literature analyzed (Table 4.12).

In all these papers, the second-order factors are found to be significantly related to performance.

Table 4.12 Second-order factors in the SCI literature

Second-order factors	First-order factors	Reference
Supply chain collaboration	Information sharing, goal congruence, decision synchronization, incentive alignment, resource sharing, collaborative communication, joint knowledge creation	Cao et al. (2010); Cao and Zhang (2011)
Supply chain collaboration	Information sharing and communication, common goals sharing, joint activities, incentive alignment	Pradabwong et al. (2017)
Collaborative competence	Supplier involvement, customer involvement, cross-functional team involvement	Mishra and Shah (2009)
Buyer-supplier collaboration	Information sharing, incentive alignment, joint decision-making	Wiengarten et al. (2013)
Physical and informational flow integration	Physical flow integration, informational flow integration	Bruque-Càmara et al. (2016)

According to Mishra and Shah (2009), the use of second-order factors helps to avoid the statistical problems deriving from highly significant correlations among first-order constructs and makes it possible to synthetize into a single variable the synergies arising from implementing several integration practices at the same time. However, we also believe that this method has some countereffects that must not be underestimated. Indeed, as apparent in our SLR, the effects of different SCI practices on performance, like internal, customer, or supplier integration, can differ depending both on the context and performance dimensions considered. Thus, a recommendation for future research on SCI is to use fit as covariation with attention, given the risk of losing the proper level of detail for an effective analysis.

4.4 Discussion and future research directions

In this section, first, for each fit form we identify the related research gaps, providing detailed directions of future research. Second, we focus on some open issues that emerged from the SLR, which in our opinion need to be addressed through the simultaneous use of different fit forms.

4.4.1 Future research directions for each fit form

4.4.1.1 Fit as mediation

A significant gap in previous literature studying fit as mediation is the limited number of studies analyzing human capital characteristics as antecedents of SCI practices. In the SCI literature, the importance of personnel and manager behaviors is recognized by many authors. For example, Pandey et al. (2012) underline that if people are not engaged enough or do not have the capabilities to implement required activities, it will be difficult to reach the targeted integration, even if all processes and systems are properly developed. Similarly, Wang et al. (2016) state that integration is implemented, controlled, and achieved through individuals who play a fundamental role in achieving SCI. We believe that further analyses on this theme are needed and we particularly suggest a more structured investigation of human capital characteristics based on a Behavioral Operations perspective. In Behavioral Operations, researchers seek to understand the implication of behaviors in operations processes, overcoming the simplistic assumption of modeling humans as hyper-rational beings motivated only by economic rewards (Croson et al., 2013). Behavioral Operations would require moving the unit of analysis from a macro to a micro-level, focusing on teams' and individuals' characteristics/behaviors instead of an organization's design and structure.

A further significant gap in the literature on antecedents of SCI is that many contextual variables are studied at a company and supply network level, whereas other influencing variables at a more macro-level lack, such as those linked to the sector, a company's country, and economic policies, etc. In this sense, Institutional Theory could represent a promising lens through which to analyze antecedents. It states that economic, social, cultural, and political conditions may have a heavy impact on firm's decisions (Lau et al., 2002). Differently from other SCM research streams (e.g., sustainable supply chain management (Zhu et al., 2013; Sancha et al., 2015; Tachizawa et al., 2015)), quantitative studies in the SCI literature do not apply this theory to interpret decisions made by companies, drivers, or forces leading to SCI (see Table 4.6). We encourage instead the application of Institutional Theory to study the fit between context, SCI, and performance as a future research direction, to complement existing studies on SCI antecedents.

4.4.1.2 Fit as moderation

Within this fit form, several suggestions and opportunities for future research can be delineated. Firstly, although important, country-related moderators represent a scarcely investigated area in quantitative studies on the SCI-performance link. Therefore, we call for additional studies extending and deepening this topic, particularly in the role of national culture. Chang et al. (2016) meta-analysis represents a first attempt in this direction. They found that the effects of internal and supplier integration on performance are stronger in Asian than in Western cultures. However, a precise picture of national culture's role has not yet been delineated. In particular, we think that an interesting research opportunity could lie in a change of perspective. Wiengarten et al. (2014) warn that, since a focal company and its customers and/or suppliers may be located in different countries, studying the focal company's country is not enough. Future studies could investigate the effects of cultural differences and distance between partners involved in the collaboration, thus focusing not on the focal company but on specific dyads as units of analysis. Beugelsdijk et al. (2018) provide an interesting discussion on the conceptualization of distance in international business research and propose a methodology to calculate a cross-country distance index. Such an index may be tested as a moderator in the SCI literature and could be applied by managers to identify the most appropriate partners for integration.

A second suggestion for future research is the role of uncertainty and complexity as moderating factors. They have been frequently analyzed by scholars over time but, from this SLR, it emerges that different types of uncertainty/complexity may have different effects according to the integration practice and the performance dimension considered. Thus, our suggestion is to further explore this issue using a fine-grained analysis, focusing on single dimensions of uncertainty and complexity at a time. This approach could lead to a clearer picture of the fit between uncertainty/complexity, integration, and performance, going beyond the simplistic view that SCI is more beneficial under conditions of higher uncertainty/complexity.

In addition, a third area which may deserve further research concerns moderators linked to the supply network structure. We believe that there could be other factors worth considering in future research, besides supplier lead times and supplier network internationalization (e.g. partner's capacity and ownership, availability of key resources, etc.). Existing case-study research provides interesting propositions to be tested with quantitative studies. For instance, Choi and Krause (2006) focus on the concept of supply base complexity, expressed as number of suppliers in the supply base, degree of differentiation, and level of inter-relationships among them, and state that a higher complexity may increase the costs of collaboration with these suppliers. Future research may test the fit between supply base complexity, integration, and performance (particularly costs).

4.4.1.3 Fit as gestalts

The results of the analyses of papers applying fit as gestalts show a lack of agreement on the advantage to developing a balanced upstream and downstream integration. In addition, authors that suggest a strong integration only in few SCI practices are not aligned on the most appropriate direction of integration (upstream vs downstream). This is certainly a topic that deserves additional analysis in future research.

Based on previous findings, one recommendation is to avoid using a single construct to measure operational performance and determine its link with gestalts, and instead use separate performance indexes, because past papers found different effects of SCI configurations on different performance dimensions (see e.g. Danese and Bortolotti, 2014). In addition, we suggest that the simultaneous application of multiple fit forms could help to advance our knowledge about the link between gestalts and performance, as discussed in the next section.

Finally, it could also be interesting to replicate and extend the studies by Mckone-Sweet and Lee (2009) or Kauppi et al. (2016) on the fit between SCI and investments in other practices. These studies argue that integration practices complement further practices that, together with SCI, can help to achieve a competitive advantage. This would make it possible to identify complementarities between SCI and other practices and therefore understand how companies could reach a better performance through a set of concerted investments. Using fit as gestalts to investigate this topic, instead of fit as moderation, would allow researchers to include a larger set of practices and look for recurring patterns, increasing the explanatory power of the model tested (Blarr, 2012; Flynn et al., 2010).

4.4.1.4 Fit as profile deviation

As the contributions relying on this fit form are limited to only three papers in the SCI field, we call for further research applying this fit category, extending previous research also to other types of integration (e.g. technological integration). If the existence of an optimal profile is also confirmed in other research areas, the debate on the integration-performance link could benefit from significant fresh contributions.

In our view, the power of a profile deviation analysis lies not only in the identification of optimal profiles, but in the opportunity to shed light on the "dark side" of SCI, as Das et al. (2006) do. Indeed, the evidence that "more integration is not always better" could explain why in some cases companies do not reach the expected levels of performance improvement and thus support managers in making decisions about SCI investments.

A further suggestion is to advance research by analyzing the effect of deviations from the optimal profile with deeper detail. For instance, once an ideal profile is found, one may be interested to understand the performance implications of under- and over-investing, compared to the ideal profile. None of the analyzed papers addresses this issue, which could provide strong theoretical and managerial insights.

4.4.1.5 Fit as matching

Fit as matching hypothesizes the existence of a theoretically defined match between two variables (e.g., strategy and structure) and claims that the absence of such a match can significantly decrease performance. The typical way to measure it is the use of the deviation score analysis, the premise of which is that the absolute difference between the standardized scores of the two variables denotes a lack of fit between them (Venkatraman, 1989). None of the reviewed papers adopts this perspective, that could potentially shed light on some open issues, such as the balance between upstream and downstream integration. Studying the match between these practices would be very useful to managers in making decisions on SCI investments.

4.4.2 Research topics that can benefit from the simultaneous application of different fit forms

We provide below two possible combinations of fit forms that in our opinion could be useful to address some open issues in the literature on context-SCI-performance.

4.4.2.1 Simultaneous application of fit as mediation and moderation

Fit as mediation and fit as moderation are very popular topics in SCI research. A few papers in the SCI field combine these two effects together (see analysis section), for example, verifying if a mediation effect remains the same across different contexts or testing if a moderation effect is transmitted through a mediator variable. Some authors refer to these models with specific terms, like *mediated moderation* or *moderated mediation* (e.g., Baron and Kenny, 1986), or with more general expressions like *conditional indirect effects* (e.g., Preacher et al., 2007). The methodology used by most of the papers analyzed consists of dividing the sample into two groups and then testing a mediation effect in both groups. However, more articulated models exist that develop and test complex relationships, which could be useful. For instance, given the relationship between an independent variable X and a dependent variable Y through the mediator M, the moderation can be specified on the path from X to M, on the path from M to Y, on the direct effect of X on Y (controlling for M), or on more of these paths simultaneously. Edwards and Lambert (2007), Preacher et al. (2007), and Hayes (2013) provide many of these statistical models, where direct and/or indirect paths of a mediation are moderated by one or more variables. Looking at the most recent publications, we found that only Vanpoucke et al. (2017) apply this framework in the SCI context.

To mention just one research opportunity in relation to Behavioral Operations, it could be interesting to study managers' risk propensity (risk-adverse or risk-seeking) as an antecedent of SCI, and the moderating role of uncertainty (e.g., market or supply uncertainty) on both the paths between risk propensity and SCI, and SCI and performance. In fact, in uncertain contexts, risk-adverse managers can try to reduce risks (e.g. stock out risks) by increasing SCI, which in turn improves performance. In these types of studies, the rationale is that some antecedents and indirect paths are particularly relevant under certain contextual conditions.

Moderated mediation can also be useful to further explore the interactions between different SCI practices. In this regard, Preacher et al.'s (2007) model, in which the variable M is simultaneously a mediator and moderator of a certain relationship between X and Y, could help to better frame the dynamics underlying the interactions between SCI practices. Indeed, if we compare the analyses of papers on fit as mediation and moderation previously described, we can see that sometimes an integration practice (e.g., external integration) is supposed to be a mediator of the relationship between another integration practice (e.g., internal integration) and performance (Huo, 2012), while in other cases the same variable (namely external integration) is supposed to interact with that integration practice (internal integration) thus sinergically influencing performance (Droge et al., 2004). Since in many papers both hypotheses are confirmed, we may suppose that such a variable has a twofold role, although nobody has ever tested if both roles occur simultaneously. We believe that a study based on Preacher et al.'s (2007) test would enrich our knowledge on the SCI-performance relationship, better shaping the complex nature of the interactions among these integration practices. From a practical point of view, understanding the role of internal integration as enabler or moderator is important. In fact, this analysis could make managers aware of the fact that not only can internal integration trigger external integration, but also that a certain level of internal integration is fundamental to obtain benefits through external integration.

4.4.2.2 Simultaneous application of fit as profile deviation and moderation

One of the gaps that emerged from the SLR, linked to the application of fit as gestalts, is the lack of agreement on the advantage to developing a strong integration in a single direction (upstream or downstream). According to some authors (e.g., Flynn et al., 2010), it is better to focus investments on few SCI dimensions rather than investing moderately in all the dimensions, while for others (e.g. Frohlich and Westbrook, 2001; Schoenherr and Swink, 2012), if companies concentrate their investments on customer or supplier integration only, they do not obtain better advantages than companies with low integration levels. A possible explanation may be that the optimal configuration of SCI practices depends on the context.

In order to better examine this issue and complement results of previous studies applying fit as gestalts, we believe that scholars could use profile deviation analysis, combining it with fit as moderation. The profile deviation analysis allows the researcher to identify an optimal level of investments for a certain set of practices, in order to maximize a given performance dimension. The basic idea in SCI is that an ideal profile may not always correspond to the highest level of implementation of all integration practices, as in Das et al. (2006). Since it is plausible that ideal profiles in SCI depend on context, the profile deviation analysis could be combined with the use of one or more contingent factors characterizing different settings. This would make it possible not only to identify ideal profiles particular to each context, but also to evaluate under which circumstances integration practices should be balanced, or alternatively, when it should be appropriate to focus on upstream or downstream integration only. For instance, when a company's supplier network is international rather than local, the resulting optimal profile deviation could be unbalanced towards upstream integration.

4.5 Conclusions

This study is an SLR of previous research on the fit between context, SCI, and performance, which classifies and analyzes 90 papers published from January 2000 to December 2018 in 17 top scientific journals. An element of originality of this SLR lies in its use of Venkatraman's (1989) fit framework to organize previous literature and related findings, providing useful insights on the most explored or under-explored contextual variables, and on the forms of fit adopted to model the relationships between context, SCI, and performance, with promising implications for both researchers and practitioners.

4.5.1 Theoretical implications

A general contribution of this work is that it provides a comprehensive understanding of the state-of-the-art research investigating the interactions between context, SCI, and performance. For each group of works applying Venkatraman's form of fit, we compare and discuss the effects analyzed by the authors and the results found. Furthermore, we identify under-explored themes and open issues. From this, we discuss several suggestions for future research, considering each possible form of fit and combinations of multiple fit forms.

Firstly, this research highlights the most investigated issues and contingencies as well as common arguments. It emerges that the most used forms of fit are mediation and moderation, which, taken together, represent more than 70% of SCI papers dealing with context. Within these categories of fit, some research topics are more popular; in the fit as mediation field, the role of SCI as an antecedent to other operations management practices, technological integration as an antecedent of other integration activities, and the role of internal integration as a prerequisite for external (or customer/supplier) integration are popular topics. In the fit as moderation field, the existing synergies between integration practices and the role of uncertainty and complexity as moderating variables are widely studied.

Secondly, this SLR identifies potential "white space" that might be fruitful for future research. A significant gap is in studies investigating human characteristics as antecedents of SCI. For this reason, we call for additional studies in SCI adopting a Behavioral Operations perspective. Another interesting lens is that of Institutional Theory, as different institutional pressures can act as antecedents of SCI, influencing companies' choices and actions. Extant literature instead focuses on antecedents at an individual, company, or supply network level. As regards moderation, a promising under-investigated contingency effect is national culture. An interesting change of perspective here would require assessment of the effect of cultural distance between the focal company and its partners. Moderating variables linked to supply network structure are also surprisingly scarcely investigated in quantitative SCI studies. One suggestion is to build on previous case-study based research to identify and test potential contingencies (e.g. supply base complexity).

Thirdly, this research suggests the application of fit as matching and some combinations of multiple fit forms, rarely used before, to address some unsolved and debated issues in SCI. Fit as matching could shed some light on the open issue of the balance between upstream and downstream integration. Mediation moderation could be useful to study the complex dynamics that can exist between external and internal integration. A further suggestion is to apply fit as profile deviation and moderation to study optimal configurations of SCI practices in different contexts.

4.5.2 Managerial implications

This SLR advises managers that assuming SCI can lead to improved performance is a risky oversimplification. Several contextual variables, external and internal to the company, can hinder or boost this effect, as tested in many fit moderation models. In addition, the mix of integration practices implemented has a meaningful effect, synergistically influencing performance, as assumed in fit as gestalt and in fit as moderation as well. Finally, overinvesting in SCI can be counterproductive, as highlighted by studies based on profile deviation analyses aiming to identify optimal profiles of SCI practices.

This SLR also informs managers of the mechanisms through which SCI affects performance and dynamics that can occur. Research based on fit as mediation identified several contextual variables acting as SCI antecedents while, in other mediation studies, SCI is seen as the infrastructure on which further practices are built.

In addition, this work provides managers and practitioners with an overview of main results found and significant contingencies in SCI, and they can refer to the related section in this manuscript to understand *what* contextual factors are considered important and *how* they interact with integration practices and performance. In addition, they can use the selected list of references in this study to deepen their knowledge in specific topics. Most of the cited papers contain explicit managerial insights.

4.5.3 Limitations

This SLR has some limitations that must be pointed out. First, we applied strict quality and content conditions (e.g., excluding other sources different from peer-reviewed journals in English language, as chapters, conference proceedings, etc.). Furthermore, the keywords used for the selection and exclusion criteria (e.g. qualitative or conceptual papers) obviously limit the final sample of our analysis, influencing the results and the discussion presented. Therefore, our SLR represents a starting point to identify future research directions and could be further extended by reducing selection criteria for papers and journals.

Chapter 5
MANAGING EVOLUTIONARY PATHS IN SALES AND OPERATIONS PLANNING: KEY DIMENSIONS AND SEQUENCES OF IMPLEMENTATION

5.1 Introduction

S&OP is a process widely studied by OM scholars and characterised by an ample body of literature (Feng et al., 2010). Several frameworks exist describing and categorizing S&OP activities and their contribution to address demand, production, supply and distribution problems (Wang et al., 2012; Tuomikangas and Kaipia, 2014). Thomé et al. (2012a) define S&OP as a process that unifies different business plans into one integrated set of plans. The purpose is to simultaneously enable horizontal alignment, balancing demand and supply plans in order to meet the forecasted demand and quickly adjust the operations in changing market conditions, and vertical alignment, linking organization's long-term strategic and short-term operational plans to achieve and sustain competitive advantage (Grimson and Pyke, 2007).

S&OP emerged as an industry practice in the 80s (Ling and Coldrick, 2009), when the need of firms to adapt to changing conditions increased and new approaches substituted the traditional operations planning and control (Olhager, 2013). It evolved from aggregated production plans (Singhal and Singhal, 2007) to Manufacturing Resource Planning (MRP II), with the aim of optimizing production and capacity plans within a single plant (Ling and Coldrick, 2009). During its evolution, it took many different names, like Integrated Business Planning, Integrated Business Management, Sales Inventory and Operations Planning (SIOP) etc. (Ling and Coldrick, 2009). With the advent of Internet, optimisation software spread and Enterprise Resource Planning (ERP) systems, the integration between functions, promoted by S&OP, has been gradually facilitated (Singhal and Singhal, 2007), and nowadays S&OP is used to align plans not only within the organisation but also across the supply chain.

Thanks to S&OP, companies can overcome the silos culture in which departments operate independently (Swaim et al., 2016), increasing the ability to compete in highly competitive environments (Pedroso et al., 2016). In general, literature is unanimous in concluding that S&OP process provides substantial benefits and has a positive effect on a firm's performance (e.g. Thomé et al., 2012b; Thomé et al., 2014). These benefits can be both quantitative and qualitative in nature; from an increase of forecast accuracy and customer service level (Wagner et al., 2014), to a reduction of inventory levels (Wagner et al., 2014; Goh and Eldridge, 2015) and an enhanced information flow between demand and supply sides (Oliva and Watson, 2010). Many papers also report that S&OP can help to overcome problems and difficulties related to new product introduction (Goh and Eldridge, 2015), context that requires the analysis of demand and supply uncertainties on future sales, making the definition of demand and supply plans quite critical for companies (see Negahban and Smith, 2016). Finally, according to Swaim et al. (2016), S&OP is also fundamental to address many challenges companies have to face nowadays, like SKU proliferation, shorter lifecycle of products, JIT practices and complex omni-channel distribution networks. In fact, S&OP makes it possible to minimize stock-outs, and improves the ability to quickly react to demand changes without increasing inventories by fostering communication and cooperation across departments.

Although S&OP benefits are well-recognized by the literature, implementing an S&OP process is still a challenging task for companies (Swaim et al., 2016). Its implementation is a highly complex activity (Pedroso et al., 2016) that involves many organisational levels (Jonsson and Holmström, 2016) and requires to link independent and sometimes adversarial departments in a company (Swaim et al., 2016). Several barriers hinder S&OP implementation and make it often difficult for companies to achieve positive results, such as silos culture, lack of participation of sales department, lack of support from senior management, rigid organisational culture, lack of training etc. (Pedroso et al., 2016). Despite this, there is a general lack of guidance in the literature regarding the implementation of an S&OP process, especially regarding improvements and actions needed over time to achieve horizontal and vertical integration (Tuomikangas and Kaipia, 2014; Pedroso et al., 2016).

A rich stream of studies on S&OP concerns the so-called "maturity models", consisting of multiple evolutionary and successive stages in the advancement of S&OP, each characterised by a precise set of dimensions (Lapide, 2005; Grimson and Pyke, 2007; Feng et al., 2008; Wagner et al., 2014). The managerial usefulness is twofold: to assess how effective S&OP processes are, and direct the evolution towards advanced stages. However, being these models specifically thought to plan the transition, rather than to execute it, they are excellent tools to identify the dimensions to address in each evolution stage, but they don't provide guidance on the dynamics of evolution from one stage to the next one. To execute the transition in real cases managers can found unfeasible or inefficient to simultaneously develop all the model dimensions, thus they need some guidelines to understand the temporal sequence to be followed to transform each dimension or, at least, how these dimensions interact each other over time.

This paper seeks to address this research gap by investigating the dynamics of interactions among the dimensions in maturity models during the transition from a maturity stage to the following one. In particular, we aimed to study S&OP transitions between different maturity stages in the evolutionary paths, in order to analyse and develop an understanding of common patterns and differences in the dynamics occurred.

Starting from a literature review on S&OP maturity models, we identified the S&OP dimensions and stages usually acknowledged in the literature. Based on this, we studied three cases of transitions between different S&OP maturity stages. The aim was not to develop a further S&OP

maturity model, but to contribute to literature on S&OP implementation and maturity models, by studying differences and commonalities in the dynamics occurred in three transitions which differ for S&OP maturity stages involved. From a theoretical point of view, this research intends to provide evidence of whether and how dynamics in a S&OP transition can be influenced by different starting and destination S&OP maturity stages. This is relevant because, as before explained, dynamics of evolution from one maturity stage to another is an under-explored issue in the literature. From a managerial point of view, this study could provide useful suggestions and advices to companies that intend to undertake the challenge of improving their S&OP process, by explaining how they could act on S&OP dimensions over time in a transition.

The paper is organised as follows. First, we review the literature on S&OP and maturity models. Then, we describe the theoretical framework we used to interpret the dynamics of the transition of S&OP systems. It follows the methodology section and the description of the three cases used to investigate how the dimensions of the framework interact and evolve over time during the transition from one stage to another of a maturity model. In the following section, we analyse the cases and discuss the theoretical and managerial implications. The paper ends with the conclusions, research limitations and future developments.

5.2 Literature review

5.2.1 S&OP process

S&OP typically follows a five-step process (Grimson and Pyke, 2007; Ivert et al., 2015b). These steps are: data gathering, demand planning, supply planning, pre-meeting and executive meeting (Wagner et al., 2014; Hulthén et al., 2016). Meeting regularity can vary from monthly to weekly (Thomé et al., 2012a), according to the specific needs of the company; the process is normally made at an aggregated level (e.g., product families), and covers a time horizon of 12-18 months (Grimson and Pyke, 2007). In step 1, periodically (e.g., every month), data of the previous period are collected and opportune KPIs are created and measured to evaluate past trends (Hultén et al., 2016). In step 2, a demand plan is created, while a rough-cut capacity plan is the output of step 3 (Hultén et al., 2016). In the pre-meeting (step 4), plans are adjusted and aligned, and finally the executive meeting (step 5) ends with plan confirmation and the resolution of any critical issues (Wagner et al., 2014).

5.2.2 Maturity models

Maturity models normally include a sequence of stages representing a development path from an initial status to a more advanced one (Poppelbuss et al., 2011). According to de Bruin et al. (2005), maturity models can be used with three different purposes: descriptive, prescriptive and comparative. They allow assessing the maturity of a discipline in a company, help creating a roadmap for improvement, and finally enable benchmarking across companies and industries. The general idea of maturity models is that the progressive pattern across the various stages of the model is beneficial to organisations (Poppelbuss et al., 2011). As they can be valuable tools to assist decision makers, maturity models have been widely applied over the years in different areas, from Information Systems (IS) (e.g. Nolan, 1979; Poppelbuss et al., 2011) and Business Intelligence (BI) (Raber et al., 2013), to Supply Chain Management (Stevens, 1989), Business Process Management (Rosemann and De Bruin, 2005) and also S&OP (Table 5.1).

Previous studies on maturity models analysed how operationalizing dimensions needed to assess maturity and defined maturity stages. Although maturity models were developed in different areas and the terminology used changes, some dimensions of maturity models are recurrent. For instance, the 'organization' dimension in BI maturity models (Raber et al., 2013) is similar to the 'people and organization' dimension in S&OP maturity models (Wagner et al., 2014), or IT dimension occurs in both BI and S&OP maturity models. Some authors also studied maturity dimensions and stages as antecedents of success, by developing frameworks integrating maturity and performance concepts. For example, Raber et al. (2013) analysed the link between maturity stages and benefits achieved in BI, while Gable et al. (2008) studied the IS-impact as a multi-dimensional concept linked to IT practices and capabilities. In S&OP, scarce attention has been dedicated over the years to integrate maturity stages and performance concepts. An exception is the study by Tohamy et al. (2013) who studied performance improvements passing from one S&OP maturity stage to another.

In the present research, in line with S&OP maturity studies, maturity will be defined in terms of companies' capabilities and practices (not performance achieved), these grouped into some major dimensions, according to literature. In fact, the aim of this research is studying how a company can act on S&OP practices and develop its capabilities over time to pass from one stage to another.

5.2.3 S&OP maturity models

Several S&OP maturity models have been developed in the literature (Table 5.1): they vary in the number of evolutionary stages as well as in the dimensions considered in their analysis of the S&OP. Though these models seem different and the terminology used significantly varies, the evolution path across the various maturity stages shows several commonalities. Indeed, all models start from a stage where companies have no planning processes and fulfil incoming orders in a reactive manner, and end with an advanced stage, characterised by proactive processes, a high collaboration and integration of plans. Moreover, in most of them, at first process improves internally, while the most advanced firms extend their collaboration and alignment efforts throughout the supply chain.

Table 5.1 Comparison of S&OP maturity models

Studies	Dimensions	Evolutionary Stages
Wing and Perry (2001)	• Information and integration technology	1. An integrated planning solution 2. Collaboration with trading partners 3. The network hub
Lapide (2005)	• Meeting frequency and type • Alignment of demand and supply plans • Technologies implemented	1. Marginal process 2. Rudimentary process 3. Classic process 4. Ideal process
Ventana Research (2006)	• People • Process • Technology • Performance Management	1. Tactical 2. Advanced 3. Strategic 4. Innovative
Grimson and Pyke (2007)	• Meetings and collaboration • Organisation • Measurements • Information technology • S&OP plan integration	1. No S&OP process 2. Reactive 3. Standard 4. Advanced 5. Proactive
Feng et al. (2008)	• Level of integration between sales, production, distribution and procurement planning	1. Decoupled Planning 2. Sales-Production Planning-Based S&OP 3. Supply-Chain-Based S&OP
Cecere et al. (2009)	• S&OP balance • Goal • Ownership • Metrics	1. Reacting 2. Anticipating 3. Collaborating 4. Orchestrating
Wagner et al. (2014)	• Process effectiveness • Process efficiency • People and organisation • Information technology	0. Undeveloped 1. Rudimentary 2. Reactive 3. Consistent 4. Integrated 5. Proactive

The models presented in Table 5.1 can support managers in assessing the maturity level of their S&OP processes and planning their evolution, passing from one stage to the next one, each characterised by a certain mix of dimensions. However, their main focus and contribution concern planning rather than execution of implementation. In other words, these models clearly describe the sequence of stages to be passed through in order to improve S&OP process (i.e., column three in Table 5.1), but when managers have to execute the transition from one stage to the following one in practice they cannot develop all the model dimensions (i.e., column two in Table 5.1) simultaneously and need some guidance on the temporal sequence to be followed to transform each dimension or, at least, on how these dimensions interact each other.

5.2.4 The theoretical framework

To address the gap discussed above we developed a theoretical framework (Table 5.2) useful to study the transition from one maturity stage to the following. The novelty of our framework does not lay in the maturity stages or in the dimensions underlying each stage, as they can be found in the existing literature (see previous section), but in the attempt to classifying S&OP dimensions in a way functional to explain the dynamics of evolution from one stage to another one rather than the characteristics of each stage.

Specifically, the proposed framework includes four S&OP dimensions: People and organisation, Process and methodologies, Information Technology and Performance measurements. People and organisation refer to the general culture and human component of the S&OP process. This dimension is linked to the goal and the overall strategy of the company (see Cecere et al, 2009) and includes features like planning culture, commitment, roles and responsibilities, as in Wagner et al. (2014). Process and methodologies regard those actions and methods used to reach the strategic goals and thus comprise all the S&OP practical activities and procedures. This includes: the S&OP structure (e.g. width of the process or process focus) (see Lapide, 2005), the degree of formalisation of the process (Wagner et al., 2014), the regularity of meetings (Lapide, 2005) and their content for the various steps of the S&OP process (Thomé et al., 2012a). Information technology includes all supporting and enabling software and the information sharing systems. As it appears evident from Table 5.1, this dimension is usually considered in several previous maturity models. Finally, performance measurement relates to the use of cross-functional KPIs to measure both a company's performance and the effectiveness of the S&OP process, according to a continuous improvement approach (Grimson and Pyke, 2007).

Our classification into these four dimensions appeared to us particularly appropriate to study the dynamics from one maturity stage to another for different reasons. First of all, a general acknowledged assumption in the literature is that process improvement initiatives require first to implement a series of tools, actions and methods to redesign the process. Once the new process has been tested and standardized, it should be automatized through a consistent and supportive IT infrastructure (Bortolotti and Romano, 2012), and appropriate KPIs should follow to monitor performance and improvements (or potential problems) in order to plan future actions according to a continuous improvements approach (Grimson and Pyke, 2007). Thus, it appeared to us useful and appropriate given the purpose of this research to differentiate IT and performance-measurement dimensions from the process and methodologies one. Moreover, we judged helpful to isolate a dimension dedicated to people and organization, in order to study how this variable fits in the sequence and interacts with the others during the transition phase. It is evident that in a S&OP project the identification of roles and responsibilities (e.g., demand manager) and involvement of personnel in the transformation of the process are important prerequisites in order to create commitment in the project and thus avoid subsequent barriers in the S&OP implementation (Grimson and Pyke, 2007; Wagner et al., 2014).

In order to define maturity stages, we decided to rely on Grimson and Pyke's (2007) model which was developed starting from Elbaum (2004) and Lapide (2005). It is considered a point of reference in the literature on S&OP maturity models (Goh and Eldridge, 2015) and has been used to assess S&OP process maturity of companies in several studies (e.g. Goh and Eldridge, 2015; Ivert et al., 2015a). Hence, as in Grimson and Pyke (2007), the maturity stages considered in our framework are five: "No S&OP process", "Reactive", "Standard", "Advanced" and "Proactive". They represent a growth path from companies with no planning processes to the most advanced and developed ones, i.e., those that extend their collaboration throughout the supply chain and outside their boundaries. In particular, a Stage 1 organization is characterised by a lack of S&OP meetings, functions and measurements: there is a silo culture domination, no formal S&OP teams, and the technology is limited to individual spreadsheets and in-house systems to support S&OP. In the second stage of maturity, demand and operations plans are aligned to a certain extent and sometimes an informal S&OP team exists; the S&OP process is not formalised and demand and supply plans are still developed independently. The support of IT is still weak, with a heavy reliance on MS-Excel files, and finally the metrics are not aligned to the business goals. Standard organisations are characterised by a new planning culture, based on collaboration and information sharing; there can be a non-dedicated S&OP team, but participants are held responsible of their tasks and evaluated based on their overall performance. The process is formalised and brings to an integrated balancing of demand, supply and inventory plans, usually through monthly meetings; the IT tools are developed to support internal supply chain processes and provide unified platforms to favour demand and supply balancing, while the metrics are metrics integrated across the departments to manage trade-offs. In Stage 4, companies collaborate and share information with main customers and/or suppliers, for instance to better sense actual consumer demand, shape and use it to drive business operations. Technology is designed to support communication and information sharing with trading partners through special web-based platforms to improve collaboration, scenario analysis and demand/supply shaping; finally, the metrics are focused on customer service levels and S&OP effectiveness. The last stage of the maturity model is almost utopian for most companies and has the goal to realise coordinated decision-making across the enterprise and network; teams are cross-functional and cross-organisational and the process becomes balanced and dynamic with event-driven meetings and an emphasis on long-term strategic plans to support the company's growth plans. Information technology includes a real-time monitoring and problem solving systems and the possibility to support the measure of current network performance. The metrics are aligned across the entire network and seek to capture company profitability and the impact on the ecosystem (e.g, social impact, global environmental impact etc.).

Table 5.2 The proposed maturity model

	Stage 1 No S&OP process	Stage 2 Reactive	Stage 3 Standard	Stage 4 Advanced	Stage 5 Proactive
People and organisation	- Lack of sponsorship from business executives - No team of S&OP - Silo culture domination	- Some collaboration between demand and operations - No definition of responsibilities	- New planning culture with non-dedicated S&OP team - Clear roles and responsibilities - Excellent commitment	- Formal S&OP team with executive participation - Collaboration with main customers and/or suppliers - Development of new skills and personnel training	- The S&OP process owner becomes coordinator of the entire network - Participation of top management of all partnering companies
Process and methodologies	- No formal S&OP process - Frequent re-planning and revenue focus	- Emerging but still inconsistent process - No financial integration	- Formalised and structured process - Regular meetings - Financial integration	- Process balanced with the external network partners - Demand and supply plans jointly aligned	- Dynamic process - Event-driven meetings
Information technology	- Individual managers keep own spreadsheets - No consolidation of information	- Many spreadsheets or functional solutions - Some consolidation but done manually	- Integrated demand and supply planning software - Improved data rationalization and integration capability	- Technology to access external partner data and share information with them	- Innovative technology to support decision making (e.g., on risk management and scenario analysis for profitable trade-offs) using information dispersed in the supply network and beyond.
Performance measurement	- Basic measurements	- Functionally specific metrics - Measure of how well Operations meets the sales plan	- Integrated internal supply chain metrics to manage trade-offs	- External supply chain metrics to support decision making at the supply network level. - New product introduction metrics - S&OP effectiveness	- Assessment of the impact on company profitability - Measurement of the impact on the ecosystem (e.g, social impact, global environmental impact etc.)

5.3 Methodology

Since studying the transition from one S&OP maturity stage to another requires a deep and accurate analysis of events occurred and their dynamics, the case study method was chosen.

5.3.1 Case study selection

Following the recommendation of Eisenhardt (1989), a theoretical sampling approach was used. In particular, we studied three S&OP transitions –from stage 1 to stage 2 (case A), from stage 2 to stage 3 (case B), and from stage 3 to stage 4 (case C). Our sample does not consider the transition from stage 4 to 5 being this latter an ideal rather than a real status. As recommended, this theoretical sampling is linked to our theoretical standpoint and research question (Yin, 2014). In fact, we assumed that dynamics in S&OP transitions may depend on the evolutionary stages involved and our research question was to study S&OP transitions occurred between different stages in the evolutionary paths, in order to analyse common patterns and differences in the dynamics.

We also applied some selection criteria deemed appropriate to reduce potential extraneous variation (Eisenhardt, 1989). First of all, companies had to belong to maturity sectors. Due to substantal differences in demand predictability and turbolence, it can be that patterns in S&OP dynamics differ between maturity and innovative sectors. A further criterion was that companies selected were medium-large sized, willing and interested to improve their S&OP process, and top management supported this change. In fact, managers coordinating S&OP transition had to have the resources, authority and freedom to act on any dimension they judged necessary (e.g. People and organisation, Process and methodologies, Information Technology and Performance measurements). Moreover, the downstream network of the selected companies had to be similar in terms of number of customers and fragmentation of demand, thus having a similar need of using a well-defined typology of Business intelligence tools. Finally, competitive priorities of companies had to be also similar, as this could influence the emphasis on the different S&OP dimensions and dynamics as well.

As discussed in the conclusion section, these criteria determine the boundaries of this research and the extent to which results can be generalizable.

In order to identify cases, initially, we looked at a list of companies, partners of our University, usually collaborating with our Departments in terms of participation to seminars and workshops for students, and joint research projects. In order to decide whether a company might provide an interesting setting for the present study, we collected some data and information on each company and their S&OP processes. Eventually, we selected three companies operating in different sectors, characterised by a different starting level of S&OP maturity, and willing to invest to further develop their S&OP process (Table 5.3). Studying different transitions in three different companies helped us to examine dynamics in the S&OP evolutionary path in a reasonable and relatively recent timespan. In fact, analysing the transition of a single company from stage 1 up to stage 4 or 5 could require even a decade. The larger the timespan, the higher the possibility that transitions between the different maturity stages could be biased by innovation in technologies or solutions for S&OP or by organization/industry changes. The three companies selected operated in maturity sectors and in BTB contexts. Even though the number of their customers was limited compared to a BTC context, however the three companies had a fragmented downstream network with numerous customers. Finally, as regards competitive priorities, all the three companies aimed to improve their delivery time.

Table 5.3 Characteristics of study organizations

Company	Products	Size	Transition studied
A	Products alternative to fresh bread	234 employees	From S&OP maturity stage 1 to 2
B	Building materials	1,200 employees	From S&OP maturity stage 2 to 3
C	Chemical materials	1,400 employees	From S&OP maturity stage 3 to 4

For Company A the most important criticalities in S&OP are the perishability of raw materials, the shelf-life of final products and the last-minute order changes required by customers. Market demand is quite stable. Customers are numerous and include large and small-scale retailers, distributors, and companies in catering and vending sectors.

Company B has a long history in the construction industry and offers a wide range of products including mortars, plasters, paints and coloured coatings. The main criticalities for S&OP are the high product variety and the fragmentation and small dimension of orders. Customers are large and small-scale retailers, wholesalers and building companies.

Company C is a subsidiary of a society headquartered in Germany and distributes chemical products for several appliances, such as catalysts, coating effect materials and special products for paper and water treatment. Market demand is heavily seasonal (products are sold only from February to June) and highly affected by weather conditions. Customers are farmers' and agricultural cooperatives and distributors.

5.3.2 Data collection

The main data collection method was semi-structured interviews with people belonging mainly to the demand and supply areas. As recommended by Yin (2014), we created a research protocol to identify the general characteristics of each company and investigate the four dimensions of the maturity model (see Table 5.4). In each company we interviewed between five and seven people (see Table 5.5). Interviews were conducted longitudinally over time, with a duration variable from 60 to 180 minutes. More precisely, the first round of interviews based on the research protocol in Table 5.4 allowed us to develop a complete picture of the starting maturity stage of the company. The subsequent rounds of interviews mainly aimed at understanding not only the current status of each S&OP dimension (investigated based on the research protocol in Table 5.4), but also changes occurred since our last round of interviews. For this reason, interviews included also an in-depth discussion on: what had happened and changed in each dimension, including unexpected changes occurred compared to what planned; perceptions on the overall progress of S&OP project; commitment of people involved in the transformation; barriers and difficulties etc. We involved the same interviewers in each round of interviews, whose frequency depended from the project advancement and varied from bi-monthly to four-monthly basis.

Table 5.4 Research protocol

		Issues investigated
General information on the company		Products; organisational structure; production processes; supply network structure; markets served; demand (trend, seasonality, uncertainty etc.).
S&OP dimensions	*People and organisation*	Organisational structure supporting S&OP activities; existence of a S&OP coordinator; characteristics of the S&OP team (departments and customers/suppliers involved); roles and responsibilities; commitment; existence of training courses on planning topics, video and in general actions useful to create and support the S&OP culture.
	Process and methodologies	Structure and formalisation of the planning processes and, in particular: Forecasting process: inputs, level (SKU, product family etc.), time frame, updating frequency, type (bottom-up, top-down), time required for the process completion, procedures. Supply planning process: inputs, perceived reliability of forecasts and demand plan, procedures. Integration of demand and supply plans: how the integration was realised, existence of a formal S&OP process, frequency of S&OP meetings, type of meetings (physical presence, video conference etc.), content of meetings, intra- and inter-organizational procedures.
	Information technology	IT features; how IT supported S&OP process; how planners and operations and sales managers used the software; use of information sharing systems.
	Performance measurement	How the S&OP effectiveness was evaluated; existence of an S&OP scorecard; measuring frequency; type of measures in the following areas: financial, managerial accounting, operational, sales, R&D and marketing.

Table 5.5 Interviews for data collection

Case	People interviewed
Company A	Sales director Supply chain director Account Production planner IT manager
Company B	Demand planner Product manager Supply planner Management control IT manager
Company C	CEO Sales director Area manager Marketing director Supply chain director Finance manager IT manager

In addition, we also participated to some formal meetings (especially S&OP ones), where we observed the interactions between the participants, and collected the main data on key performance indicators. Finally, company visits enabled the direct observation of the personnel during the practical implementation of their activities and the use of SW solutions for S&OP.

5.3.3 Data analyses

Data analyses relied on within- and cross-case analysis. In the within-case analysis, data was broken down and grouped in order to illustrate each S&OP dimension, assessed both for the starting maturity stage and the stage achieved after the transition (see section 5.4). In addition, for each case, we mapped all the actions undertaken to realize the change over time, thus representing in a timeline the temporal sequence of actions during the S&OP transition (see section 5.4). Once the within-case analyses was done, we conducted a cross-case analysis, where we compared and contrasted the temporal sequences in the three S&OP transitions, in order to find common patterns and differences and developing an understanding of these commonalities and differences (Choi and Hong, 2002) (see section 5.5 and Table 5.9).

5.4 Case description

This section describes the S&OP transitions in the three case studied. For each company we explain the starting maturity stage and that achieved after the transition, as well as the actions executed to realize the change. It should be noted that, in line with the interpretation model (Table 5.2), a maturity stage can be associated to each dimension. We assume that the company maturity stage is equal to that of the less mature dimension (e.g. if three dimensions are in stage 3 and one in stage 2, the company is still in stage 2). The description below seeks to emphasize the temporal sequence of implementation of the interventions and the model dimensions they mainly addressed (in brackets). We use the following abbreviations: “O” for people and organization, “M” for process and methodologies, “IT” for information technology and “P” for performance measurement.

5.4.1 Company A

At the beginning of the S&OP project, Company A had a functional organization with a strong focus on production efficiency. Each department pursued its own goals and the planning process was dispersed among the functional silos with no or weak coordination mechanisms, poor inter-functional interactions and no use of advanced planning methods. The S&OP could be associated to a stage 1 of maturity (see Table 5.6).

Because of the frequent stock-outs, especially during promotions, which determined strong customer dissatisfaction, the management launched a company assessment to identify the areas that needed to be improved. The main problems found were: lack of information sharing between functions; inadequate definition of the demand plan also because of a poor management of promotions; inefficient use of planning tools, with too many manual steps. In particular, the demand planning process resulted to be the most critical one, with a forecast accuracy of about 50%. Thus, the first step was the promotion of a new planning culture, focused more on customer attention and time-based competition rather than on operational efficiency, and aimed at increasing communication and collaboration between departments. The company introduced a formal demand planner role (O) and an S&OP team (O). The former is responsible for collecting forecasts proposed by the accounts, controlling and validating them, while the latter contributes to discussing the alignment between demand and supply plans, finding their proper balance. In order to support the realisation of this alignment, a monthly S&OP meeting, held by the team defined above, was then established (M).

Then the company focused on the demand planning to address the following problems: the forecasting process was based only on historical data, promotions were not measured or managed and the final numbers defined by the accounts were too qualitative in nature. Therefore, external experts were consulted to analyse the company’s time series and identify, through the application of techniques of sales cleaning and forecasting, the most appropriate algorithm to avoid the above described problems. This provided a baseline forecast, following the trend of the time series, on which the accounts had to sum the promotional activities, creating the proposed demand plan (M). The MS-Access file used for the forecasting process was then improved to implement the new algorithm, thus discouraging the use of informal files and reducing manual work (IT). Finally, a forecast accuracy measure (P), with the supporting SW tool (IT), was introduced to monitor the process performance.

Table 5.6 Within-case analysis - Transition of Company A

	Company A		
	Before	**Actions**	**After**
Maturity stage	Stage 1		Stage 2
People and organisation	Stage 1: • No S&OP team. • Lack of communication and information sharing between demand and supply sides.	• Creation of the S&OP team, with representatives of sales and supply departments, aimed at integrating their plans. • Introduction of the demand planner role to coordinate interactions between demand and supply sides and promote their collaboration.	Stage 3: • Existence of a formal S&OP team. • Collaboration between demand and supply sides.
Process and methodologies	Stage 1: • Unstructured forecasting process: qualitative evaluations based on historical data only. • No S&OP meeting.	• Introduction of a baseline forecast as input for the demand planning process and new management of promotions. • Establishment of a meeting, with monthly frequency, involving the S&OP team.	Stage 2: • Structured and formalised planning steps. • Monthly S&OP meeting. • Financial integration not yet realised.
Information technology	Stage 1: • Use of MS-Excel and MS-Access files. • High reliance on informal spreadsheets by the sales force.	• Improvement of the existing formal MS-Access file used by the sales force to discourage the use of informal solutions. • Introduction of a technology to enable and support performance measurement.	Stage 2: • Use of formal MS-Excel and MS-Access files. • Existence of a performance IT supporter.
Performance measurement	Stage 1: • Measures on production efficiency only. • No measure of performance on the demand side.	• Introduction of forecast accuracy measure.	Stage 2: • Functionally specific measures: production efficiency and forecast accuracy.

5.4.2 Company B

Company B has recently been facing a strong change of the entire organizational structure and in particular of the planning processes. Initially the company faced a very low complexity, with few articles and sporadic big orders. Product availability and delivery times were the key strategic priorities. Demand and supply departments developed their plans independently, but organized informal meetings to align and improve them. The S&OP could be associated to a stage 2 of maturity (see Table 5.7). Over time, customers' needs have been gradually changing and the company had to adapt, creating new business lines, multiplying the articles and reducing lot sizes. This increased complexity required modifications of internal planning processes, a reinforcement of the supply department and a higher formalization of processes and activities to guarantee internal integration. These reorganizational efforts moved the company to a stage 3 of maturity (see Table 5.7).

Table 5.7 Within-case analysis - Transition of Company B

	Company B		
	Before	**Actions**	**After**
Maturity stage	Stage 2		Stage3
People and organisation	Stage 2: • Collaboration between demand and supply departments without a formalised structure. • Roles and responsibilities not clearly defined.	• Creation of a (non-dedicated) cross-functional S&OP team (with representatives of sales, production, procurement, logistics and finance departments). • Creation of a new organizational unit: integrated logistics. • Formalisation of the demand planner and supply planner roles.	Stage 3: • Existence of a formal cross-functional S&OP team (non-dedicated). • Clear roles and responsibilities.
Process and methodologies	Stage 2: • Demand and supply plans developed independently. • Informal and not structured (S&OP) meeting between demand and supply sides to solve current mismatches of the relative plans.	• Definition of a new methodology for the forecasting process. • Introduction of a formal S&OP meeting, with monthly frequency, to align demand, supply and finance plans of the company.	Stage 3: • Formal and structured S&OP meeting. • Financial integration: use of demand plan to update a rolling budget created by the management control.

Table 5.7 (continued)

	Company B		
	Before	**Actions**	**After**
Information technology	Stage 2: • Use of a simple algorithm for the forecasting process. • Use of a SAP system extension and high reliance on several MS-Excel and MS-Access files for supply planning.	• Implementation of a new SW for the forecasting process. • Introduction of an APS system with a CRP module for supply planning. • Introduction of a technology to enable and support performance measurement.	Stage 3: • Advanced technologies for demand and supply planning. • Existence of a tool to support end-to-end supply chain measures.
Performance measurement	Stage 2: • Heterogeneous, non-integrated and functionally specific metrics.	• Introduction of forecast accuracy measure. • Introduction of service level measures. • Introduction of materials planning measures.	Stage 3: • Integrated set of measures to evaluate the performance of the supply chain (service level).

The first project involved the supply department, with the creation of a new organizational unit, the integrated logistics, to manage all the processes related to procurement, logistics and planning (O). This step required the selection and training of the demand and supply planners, as well as the definition of their specific responsibilities (O). We must underline that these roles already existed in the company, but they did not act in a structured way and were nor formally defined. After that, Company B created a non-dedicated S&OP team, involving also the finance manager (O). After some time, this team found useful to formalize the interactions between departments by establishing a monthly S&OP meeting with the aim of aligning not only demand and supply plans, but also the financial ones (M).

Some months later, the team deliberated to rethink the forecasting process adopting an inter-functional consensus approach (M) that required to leave the old MS-Office based tool and to buy a new SW tool specifically dedicated to forecasting (IT); investments regarded also the supply side, with the development of a technology to support the Capacity Requirement Planning (CRP) module and improve supply planning activities (IT).

Finally, new performance measures (P), with the relative supporting tools (IT), were introduced.

5.4.3 Company C

At the beginning of the project, Company C had an advanced S&OP process that could be associated to a 3 stage of maturity. The main planning processes, formal and well structured, were supported by a good collaboration between the key business functions, especially marketing, supply chain and finance, which every month created a consensus forecast, then approved by senior management. However, despite the application of an advanced model, the company had some integration problems both internal, especially with the sales area that did not actively take part in the cross-functional S&OP team, and external, being the process very self-referential and not paying enough attention to customers. Focusing mainly on these issues, the company then launched a program of investments and reached a more advanced stage of maturity (see Table 5.8).

In order to assess customers' needs, the company launched a survey. Based on empirical evidences gathered, it then redefined its long-term goals (O) and only at this point started the development project.

First, Company C reinforced relationships with the key customers (chosen on the bases of revenues and strategic importance) by creating opportunities to cooperate in joint projects (O). Initially, Company C convinced the key customers to take part to the forecast annual meeting, with the aim to jointly define with the sales personnel the seasonal consumption (M). In this way, the company also increased the sales area involvement, which was already included in the S&OP team, but from now became the main reference point for customers.

Subsequently, the company redefined the S&OP meeting (M), splitting it into two phases (long-term and short-term oriented), and simultaneously invested in training on planning issues, in particular, on the cause-effect relationships among planning decisions (O). These actions increased organizational awareness of the choices made in the S&OP meetings and improved internal integration, both in terms of alignment between short-term and long-term plans, and in terms of process feedbacks to all business areas. At the end of this re-organization, a "Rules book" was created which formalized all the procedures, roles and responsibilities (O).

After these changes related to organisation and processes, Company C developed, together with the main customers, a collaborative portal based on a web-interfaced technology. This allowed the customers to entry confirmed orders and share with Company C their monthly sales forecast (IT). In this way, the sales personnel could adjust the consumption defined with the customers in the forecast annual meeting, according to the new information provided and updated on the portal during the year.

Finally, as regards performance measurement systems, Company C already used a wide set of indicators, therefore it had to introduce only few missing KPIs, related to customer service level and deviation from financial plans (P).

Table 5.8 Within-case analysis - Transition of Company C

	Company C		
	Before	**Actions**	**After**
Maturity stage	Stage 3		Stage 4
People and organisation	Stage 3: • Existence of a non-dedicated S&OP team, involving marketing, supply chain, controlling and regulatory areas, but with passive participation of sales personnel. • Well-defined organisational structure, but procedures not always formalised. • Direct participation of CEO in the S&OP meeting.	• Redefinition of the long-term goals using empirical data from a survey on customers' needs. • Education of personnel on the effects of S&OP decisions. • Involvement of the main customers in the forecasting process. • Formalisation of procedures (creation of the "Rules book").	Stage 4: • Formal and complete S&OP team. • New skills of the personnel (S&OP awareness). • Collaboration with the main customers in the forecasting process.
Process and methodologies	Stage 3: • Forecasts provided by two departments, area managers (sales) and crop managers (marketing), and then combined in the S&OP meeting. • Two monthly phases of S&OP: o S&OP meeting, between the S&OP team; o Executive meeting, with the involvement of the CEO and the functional directors. • Use of S&OP output to create long-term and short-term financial plans.	• Creation of a new meeting in the forecasting process at the beginning of the year with the involvement of the main customers. • Separation of S&OP meeting into two main steps: o Long-term S&OP, with a horizon of three years and a two times per year frequency; o Short-term S&OP, with a horizon of two years and monthly frequency.	Stage 4: • Collaborative meeting with main customers. • Use of S&OP meeting to support the long-term goals of the company.
Information technology	Stage 3: • Advanced tools for demand and supply planning. • Use of a Business Intelligence (BI) tool to generate reports and evaluate past performances.	• Development of a collaborative portal to share information with main customers.	Stage 4: • Use of a technology to share information on sales forecasts with main customers.

Table 5.8 (continued)

	Company C		
	Before	**Actions**	**After**
Performance measurement	Stage 3: • Use of financial indicators. • Supply Chain Scorecard: measure of indicators linked to S&OP (from forecast accuracy to inventory related measures), with the definition of trends and targets.	• Introduction of customer related measures: service level, punctuality. • Introduction of a measure of financial plans deviation.	Stage 4: • Complete set of measures to evaluate internal and external performance.

5.5 Analysis and discussion

Once collected all the information described above, we compared the three cases focusing on the interactions between the four dimensions of our framework during the transition in the evolution model. In order to facilitate this activity, we summarised the three transitions identifying the main steps the companies passed through and associated to each step the dimension, or the dimensions, that were most involved during the execution (Table 5.9). This comparison made it possible to identify some commonalities and some specific features of each single case.

A first result is that, in all the cases, the actions implemented to execute the transition addressed all the four dimensions, which at the end of the transition reached the improved stage of maturity needed to achieve the following evolution stage. Thus, as in Wagner et al. (2014), this study confirms that the transition to a more advanced stage requires a balanced action and performance on all such decisional areas, in order to achieve the desired mix of the four dimensions.

Second, our research contributes to literature by shedding light on the temporal sequence of implementation of the four dimensions. As explained in the section 5.2.2, scholars provide several arguments suggesting that interventions on "people and organization" should precede the others (Grimson and Pyke, 2007; Wagner et al., 2014) and that interventions on "process and methodologies" should precede improvements in IT and performance measurements areas (Bortolotti and Romano, 2012). Our research partially confirms these basic assumptions. In fact, on the one hand, in all the three companies (see Table 5.9), actions on the development of the organizational structure tend to precede improvement of processes and methodologies, and this latter is addressed before the introduction of new IT tools and the definition of appropriate performance indicators. On the other hand, our study demonstrates also that, although useful to provide general guidelines about the transition from one maturity stage to another, these assumptions are too simplistic to disentangle the complexity underlying such a transition. In fact, we found that the sequence including the four dimensions is far from being purely serial (i.e., one dimension after the other), and that the degree of "seriality" depends on the evolution stage of S&OP process.

Table 5.9 Cross-case analysis - Summary and comparison of the three transitions

	Dimensions involved	**Sequence of actions implemented to execute the transition**
Company A	O	1. Introduction of the formal demand planner role; creation of the S&OP team with representatives of sales and supply departments.
	M	2. Establishment of a monthly S&OP meeting, involving the S&OP team.
	M	3. Adoption of a statistical forecast algorithm to calculate the baseline forecast as input of the demand planning process and management of promotions.
	IT	4. Improvement of the existing formal MS-Access file used by the sales force..
	P - IT	5. Introduction of a forecast accuracy measure; introduction of a SW to enable and support performance measurement.
Company B	O	1. Creation of the new integrated logistics organizational unit; selection and training of the demand and supply planners; formalization of their specific responsibilities.
	O	2. Creation of a (non-dedicated) cross-functional team of S&OP (with representatives of sales, production, procurement, logistics and finance departments).
	M	3. Establishment of a monthly S&OP meeting to align demand, supply and finance plans.
	M – IT	4. Definition of a new methodology for the forecasting process; implementation of a new forecasting SW.
	IT	5. Introduction of an APS system with a CRP module for the supply planning.
	P - IT	6. Introduction of forecast accuracy, service level and materials planning measures; introduction of a technology to enable and support performance measurement.
Company C	O	1. Redefinition of the long-term goals using empirical data from a survey on customers' needs.
	O – M	2. Reinforcement of relationships with key customers by creating opportunities to involve them in joint projects; involvement of the key accounts in the forecast annual meeting, with the aim to jointly define with the sales personnel the seasonal consumption.
	O – M	3. Training of personnel on the effects of S&OP decisions; separation of S&OP meeting into two steps (long-term and short-term S&OP).
	O	4. Formalisation of procedures, roles and responsibility (creation of the "Rules book").
	IT	5. Development of a collaborative portal to share information with main customers.
	P	6. Introduction of customer related measures: service level, punctuality; introduction of a measure of financial plans deviation.

Note: O = "people and organisation", M = "process and methodologies", IT = "information technology", P = "performance measurement".

In fact, as emerges from Table 5.9, in Company A the dimensions are addressed one after the other in an almost pure serial way, except for the introduction of a forecast accuracy measure (P) which simultaneously required a SW to enable and support performance measurement (IT). Instead, in Company B seriality has been broken in advance as compared to Company A. After an initial focus on “people and organization” and then on “process and methodologies”, the management had to rethink the forecasting process and in parallel improve the SW supporting it. Finally, in Company C seriality has been broken almost immediately as the “people and organization” and “process and methodologies” dimensions are so interdependent that the management addressed them in parallel. For instance, in Company C to execute the decision to separate the ongoing S&OP meeting into two distinct meetings (one for long-term and the other for short-term S&OP targets), management had to simultaneously train the personnel involved in the meetings on the causal effects and interactions among the decisions made in the two meetings. Without this training, people could have misinterpreted the reasons leading the management to modify a process that was considered almost perfect. The consequences on the execution of the transition could have been really negative: low engagement, bad attitude, longer implementation times, decisional errors, etc.
The gradual loss of seriality with increasing maturity can be explained by looking at the peculiarity of each transition from one stage to the following. Specifically, transitions from stage 1 to 2 require companies to improve their S&OP processes, by implementing new S&OP procedures involving just few departments and supported by simple IT tools (e.g. based on spreadsheets), and to create new roles and a seminal S&OP organization culture from a “greenfield” context. In this case, it is plausible that companies can follow the almost purely serial sequence suggested by literature, addressing one dimension after the other, starting from people and organization. Instead, the transition from stage 2 to 3 requires a significant change of existing S&OP process to achieve interfunctional integration that has to be supported by a consistent advancement of ITs, since MS-Access or Excel files are no longer enough to support the new S&OP integrated process. Since IT design and its features are fundamental to support step-by-step the new S&OP procedure fostering interfunctional integration, this transition can imply that the new S&OP methodology and the relative IT systems are addressed simultaneously. Finally, the transition from stage 3 to 4 requires to redesign the process and methodologies dimension in order to improve both the horizontal and vertical directions of S&OP integration, and this can reasonably lead to simultaneously involve the organization dimension.
Empirical evidence summarised in Table 5.9 also indicates that the loss of seriality, which increases with process maturity, makes the advanced transitions more difficult to realise. Starting the S&OP improvement path from a low maturity stage is relatively simple as the key dimensions can be addressed in series, but as the maturity increases, seriality is broken earlier and earlier, and in the most advanced transformations some dimensions – such as “people and organization” and

"process and methodologies" – are so strictly connected that melt into each other. Thus, S&OP implementation seems to follow a path different from that of several other improvement programs (e.g., lean management or six-sigma) which are characterized by a strong initial barrier – usually due to a cultural gap – that, if appropriately faced, opens the way to an easier execution of subsequent phases (Boscari et al., 2016). Instead, in the case of S&OP, the path towards higher maturity stages becomes more and more difficult because of the increased interdependence among the model dimensions, which requires managing them in combination. This explains why several studies argue that most companies are not able to go beyond the lower part of maturity models just because of the difficulty to build an appropriate growth pattern (Ventana Research, 2006; Gartner, 2010).

Third, this study shows that when the transition concerns the more advanced stages in the maturity model, the "organisation and people" dimension becomes more and more important. This appears evident comparing the scope of actions on the "O" dimension in Table 5.9. Company A merely creates the demand planner role and the S&OP team with representatives of sales and supply departments. Company B established a new organizational unit responsible for integrated logistics, formalized and trained the demand and supply planner roles, and created a quite more complex and cross-functional S&OP team. Company C extended even more the scope of S&OP by involving key customers in forecasting (horizontal alignment beyond the company's boundaries) and by defining short-term operational plans also considering the business strategy long-term goals (vertical alignment). Also visiting the three companies and interviewing people in different periods during the transitions, we realised that while changes in process and methodologies, IT, performance measurement came relatively fast and without particular interruptions, changes in "organisation and people" dimension required time to engage people, achieve their commitment, and leave them the opportunity to understand and interiorize changes in the S&OP process. This means that the creation of a proper organisational structure and the diffusion of an appropriate mindset are not only crucial elements of the S&OP process, as emerges from the literature (Wagner et al., 2014), but they acquire a growing importance as the maturity stage increases, becoming the main area to be addressed in the execution phase. The increasing complexity in addressing the "organisation and people" dimension is justified by the higher degree of organizational pervasiveness, namely the number of departments involved, accompanying more advanced maturity stages, which in turn entangles personnel training and S&OP team organisation and functioning. While in Company A the changes were circumscribed to a single functional area (i.e., the Sales Department), in Company B they involved all the departments contributing to the planning processes with the aim to improve internal alignment. Company C engaged also people beyond departments directly contributing to planning (such as the key customers), with the aim of aligning the whole company to market requests. Therefore, it seems that the growth path starts from an investment on demand related issues, continues with an improvement of all the internal planning structure and ends with the adaption of the company to the external world. On the one hand, this result confirms Thomé et al. (2012a) who indicate improved forecasts and better demand plan as initial drivers for S&OP evolution, on the other the idea to proceed with internal alignment and finally with external is agreed by Lapide (2005) and, more in general, is a recognised sequence in SCM literature since the seminal papers by Stevens (1989) and Cooper et al. (1997).

5.5.1 Managerial implications

Based on the results found, it is possible to identify some guidelines for managers willing to invest in their S&OP processes to achieve an advanced stage of S&OP maturity.

First, we observed that in every company the actions implemented to execute the transition involved all the four dimensions (i.e., people and organisation, process and methodologies, IT, and performance measurement). As a consequence, when planning an improvement in their S&OP process, managers should not focus their attention only on new forecasting methods, processes and procedures and the relative IT tools (namely the process and methodologies and IT dimensions), as it sometimes happens, but should plan an improvement project including the redesigning of performance measurement and addressing organisational issues (e.g., new roles, S&OP team, training etc.).

Second, our research warns managers not to underestimate the criticality of the people and organisation dimension, whose importance grows in the S&OP transition as the maturity level increases. While in the transition from stage 1 to 2, defining new roles and building a S&OP team help starting creating a S&OP culture, in the transitions from stage 2 and 3, and even more from 3 to 4, the magnitude of the change in terms of departments and actors involved (horizontal alignment) and integration of strategic and operational plans (vertical alignment) requires to spend several efforts to involve and engage people (e.g. training) and making S&OP team effective (strengthening of relationships with external partners, creation of the rules book, etc.). In particular, in the transition from stage 3 to 4, the pervasiveness of the change does make difficult to address the process and methodologies dimension without considering the people and organisation one.

Overall, this research helps managers to organize their S&OP improvement in several ways. First of all, based on the interpretation framework of Table 5.2 derived from the literature, managers could assess the as-is situation of their company by positioning it in the four dimensions suggested, and could understand what the following maturity stage would require for each dimension. Then, depending on the transition they should undertake, this research provides some guidelines on how addressing the execution from one stage to another, considering how the four dimensions can interact over time. This can be useful to prevent potential causes of failures (e.g., the implementation of an IT whose functionalities do not adequately support interfunctional integration passing from stage 2 to 3) and barriers (e.g., a lack of commitment to change due to insufficient or late training from stage 3 to 4), thereby planning in advance potential countermeasures.

5.6 Conclusions

This paper analyses the execution of the transition between maturity stages in S&OP, thus contributing to existing literature on maturity models. We first identified four dimensions that, according to the literature, play a key role in explaining the evolution of S&OP. Then, we developed an interpretation framework (Table 5.2) that characterizes these key dimensions according to the various stages of the S&OP evolution path. We used the interpretation framework to analyse three case studies with the aim to understand how the four dimensions interact with each other in contexts characterized by different maturity stages. Our results confirm that the transition to a more advanced S&OP maturity stage requires a balanced execution of all the key dimensions, but also demonstrate that it makes no sense to search for a unique and best temporal sequence of implementation. Specifically, we found that (1) the sequence is not serial, (2) the degree of "seriality" depends on the evolution stage of S&OP process, and (3) the importance of the "organisation and people" dimension increases for those transitions involving more advanced maturity stages.

Besides the theoretical and practical contributions of this study, we think that reasoning on its boundaries and limitations can suggest interesting areas for future research. In this research, case selection criteria determine the boundaries of the present study and the extent to which results can be generalizable. The selected companies belong to maturity sectors, are medium-large sized companies willing and interested to improve their S&OP process, have a fragmented downstream network with numerous customers, and value time-based competition. In other contexts, it can be that other implementation sequences when passing from stage 1 to 2, 2 to 3 or 3 to 4 are possible. Further studies in similar and different contexts could help to corroborate or complement results found on the transition from one maturity stage to another, and to understand whether and how the growth patterns are influenced by the context and companies' planning environment (Danese, 2006; 2011). Linked to this, an interesting research direction lies in analysing the contextual conditions which can influence dynamics in S&OP transitions through the lens of contingency theory (Sousa and Voss, 2008). This approach suggests to identifying potential important contingency variables to distinguish between contexts, grouping different contexts based on these contingency variables, and determining the most effective S&OP dynamics in each group. This would require to study an appropriate sample of companies, e.g. in maturity vs innovative sectors, with different demand networks etc.

In addition, in this study we did not consider the transition from stage 4 to 5 because nowadays this last stage, even though contemplated in maturity models (Table 5.1), is still considered an ideal status which companies should strive for, whereas real examples and even pilot projects lack (Grimson and Pyke, 2007). Thus, it is currently difficult to study transitions towards stage 5. This opens some interesting opportunities for future research. First al all, action research in collaboration with companies advanced in S&OP and willing to invest to reach stage 5 could help to study the transition project towards this stage in terms of barriers, enablers, sustainability of such S&OP process over time etc. In addition, a Delphi-method based research could help to understand why it is considered an ideal status, conditions for this, and potential benefits.

Moreover, our study analysed three transitions: from stage 1 to 2, from 2 to 3 and from 3 to 4. It could be interesting to further comprehend dynamics in S&OP maturity models by examining whether and when it can be convenient to bypass a maturity stage, by questioning the basic assumption that a company should pass across all the maturity stages.

Furthermore, we studied three transitions and the dynamics between the four dimensions identified as critical. However, this research does not aim to analyse whether these transitions can be considered optimal in terms of costs, resources, time elapsed or quality of the solutions adopted.

Finally, a stimulating area for future studies on S&OP maturity models concerns the integration of S&OP maturity and performance concepts, as in Raber et al. (2013). This would allow to achieve a more complete understanding of the phenomenon, by providing evidence of benefits that could be achieved passing from one stage to another in terms of efficiency, quality of the information provided, forecast accuracy, employees' satisfaction, supplier and customer relationships etc.

Chapter 6
IMPLEMENTING SUPPLIER INTEGRATION PRACTICES TO IMPROVE PERFORMANCE: THE CONTINGENCY EFFECTS OF SUPPLY BASE REDUCTION

6.1 Introduction

Supplier integration (SI) is a widely studied practice indicating the degree to which a firm cooperates, exchanges information and develops partnerships with upstream partners (Schoenherr and Swink, 2012). Although the general opinion is that SI is beneficial for companies, the literature dealing with its relationship with performance shows contrasting results (Danese, 2013). Many authors have thus focused the attention on the role of context, investigating the effect of different moderating factors to understand their potential influence in shaping the relationship between SI and performance. Many of these contextual factors are related to the external environment on whom the firm has typically little or no control. Some examples are supply, demand or technological uncertainty (Koufteros et al., 2005), supply chain complexity (Caniato and Größler, 2015), but also national culture (Wong et al., 2017) and country's rule of law (Wiengarten et al., 2016). However, there can be other contingent factors influencing the relationship between SI and performance that are under control of the focal firm, such as other supply chain management practices or initiatives. Identifying these factors represents an important contribution for both theory and practice, because it allows to understand how they should be combined with SI to exploit their synergic effect and maximize performance.

Despite its relevance, this second stream of studies on SI is less popular. Here, scholars studied interactions between SI and other supply chain integration practices, such as customer integration (Danese and Romano, 2011a) or internal integration (Flynn et al., 2010), while other important contingent factors or initiatives, in particular those related to the supply network structure and design, have been overlooked. The few exceptions are the creation of a fast supply network structure (Danese, 2013), the use of an international supplier network (Danese et al., 2013) and global purchasing (von Haartman and Bengtsson, 2015).

Surprisingly, an interaction that has not been investigated yet is that between SI and supply base reduction or rationalization, an approach consisting in the reduction of the total number of suppliers that are actively managed by the focal company (Narasimhan et al., 2001; Sarkar and Mohapatra 2006). Supply base reduction decisions, besides requiring the evaluation of a trade-off between the consequences of concentrated and dispersed supply bases (see Choi and Krause, 2006), may also influence the achievement of SI benefits. However, the literature is not clear in suggesting if companies should combine SI practices with initiatives aimed at reducing the supply base, and research explicitly analyzing this synergic effect is scarce. On the one hand, in a collaboration with few suppliers, interactions are easier and more efficient, information is exchanged quicker (Choi and Krause, 2006) and trust and interdependence developed between the parties makes them more effective in developing new ideas (Ates et al., 2015). On the other hand, it is also true that a cooperation with a larger supply base ensures more flexibility (Lu and Shang, 2017) and provides more opportunities not only for cost reduction, but also for improved innovation, because the focal company is not locked-in to few suppliers and their technologies (Swink and Zsidisin, 2006; Ates et al., 2015) and has the possibility to access more knowledge sources (Choi and Krause, 2006).

To address this research gap, this paper explores interactions between SI, supply base reduction and two performance dimensions, efficiency and innovation. The aim is not only to extend our knowledge on the main effects of SI on efficiency and innovation, but also to verify if interactions between SI and supply base reduction impact these two performance dimensions. We chose efficiency and innovation as dependent variables because they represent the proxies of two strategic approaches for outperforming competitors in the industry, i.e. cost efficiency and differentiation (Wiengarten et al., 2016). As underlined by Porter (1998), it is rarely possible that firms successfully pursue both these strategic approaches as primary targets. Therefore, in considering both performance dimensions, we attempt to verify if the effects of the interactions between SI and supply base reduction are the same for cost leaders and differentiators. In addition, to make the investigation more precise and complete, we further separate SI into different constructs, distinguished by the goal of the activities, their time frame and the media of exchange. These fine-grained dimensions of SI depict the variety and complexity of supplier integration activities, which are not necessarily implemented together by companies and may interact in a different way with the contextual variables and the other managerial practices. Therefore, using this distinction, the present work disentangles the complementary effects between each SI dimension and supply base reduction, comparing their impact on performance. The importance of such analysis, as underlined also by Leuschner et al. (2013), is the possibility to identify what type of integration can bring the highest benefits for firm performance when combined with a reduction of the supply base size. According to our knowledge, this is the first analysis that includes a separated investigation for different types of SI and it thus stands out from previous studies that used a uni-dimensional operationalization (e.g. Vickery et al., 2003) or focused on a single type of supplier integration (e.g. Koufteros et al., 2005).

While we acknowledge that supply base reduction is only one possible contingent factor that may interact with SI practices, our study offers at least three main contributions. First, it extends our understanding of the main impact of different SI dimensions on performance, stressing the importance of adopting a fine-grained approach. Second, it theoretically argues and empirically shows that, in order to maximize performance, companies must implement SI initiatives together with actions aimed at reducing their supply base. Third, it contributes to the supply sourcing literature, suggesting that SI is one of the factors to take into consideration in order to evaluate the convenience of relying on a large vs reduced supply base.

The rest of the paper is structured as follows. Next section provides a literature review on SI, its relationship with performance and the contingent role of supply base reduction, which results into the development of a set of hypotheses. This is followed by the description of research methodology and results. Finally, we provide a discussion of the research implications and a conclusion section with the main limitations of the study.

6.2 Literature review and research hypotheses

6.2.1 Supplier integration conceptualization

The conceptualization of supplier integration has been object of numerous studies: several definitions and underlaying dimensions can be found, which emphasize different goals, time-frames, levels of information exchange, media of exchange, and interactions among business functions. While some studies employ a broad uni-dimensional operationalization (e.g. Vickery et al., 2003), others focus on specific activities that include information sharing (e.g. Prajogo and Olhager, 2012), the use of technological links with suppliers (e.g. Sanders, 2007), operational coordination (e.g. Sanders, 2008), and collaboration in new product development (e.g. Koufteros et al., 2005).

Some scholars distinguish between operational and strategic supplier integration activities (see e.g. Leuschner et al., 2013; Mackelprang et al., 2014). Operational supplier integration refers to the degree to which the organization coordinates and synchronizes with key suppliers the day-to-day activities such as operational planning, scheduling, order processing, material handling and shipment schedules (Flynn et al., 2010; Peng et al. 2013). In contrast, strategic integration concerns longer-term collaborative activities dealing with relationship building, technology development, resources and cost sharing, and strategic alignment (Swink et al., 2007). While the former activities are on-going, the latter tend to be episodic, as they are focused on particular initiatives with specified beginnings and ends such as changes in the network structure, reaction to quality problems, and development of new products or product lines (Zacharia et al. 2011).

Leuschner et al. (2013) introduce a further dimension, transversal to the previous ones as it regards the means through which supplier integration activities are accomplished. They label this dimension "information integration" that refers to the coordination of information transfer among firms in the supply chain and the relative supporting technology.

To grasp a fine-grained picture of supplier integration and its outcomes, we investigated the separate contributions of the dimensions just described by using four different constructs. Two of them, *supplier development* and *supplier involvement in NPD*, represent strategic, more episodic collaborations that focus on developing resource capabilities and product/process designs. *Operational coordination* reflects more continuous integration and synchronization of production plans and transactions. Finally, *IT integration* concerns the use of information systems and e-business technologies to share information. Below, we provide a description of these dimensions, together with a short discussion of the literature dealing with their relationship with performance, which is further summarized in Table 6.1.

6.2.2 Relationship between supplier integration dimensions and performance

Supplier development is defined as collaborative efforts such as training, consulting, and technical support, initiated by a buying firm to improve the capabilities and performance of its suppliers (Krause et al., 1998). The benefits of supplier development are widely recognized in the literature (see Table 6.1) and range from cost reductions to improvements in operational performance and in new product launches. However, some scholars point out that supplier development initiatives can be costly, and creation of relationship-specific assets through intense supplier development programs has associated risks (Li et al., 2007; Krause et al., 2007). Being this latter a less widespread view, we hypothesize that:

HP1: Supplier development has a positive effect on (a) efficiency and (b) innovation.

Supplier involvement in NPD means that buyers' and suppliers' engineers work together, often creating specific NPD teams, to jointly design new products, processes or services (Koufteros et al., 2005; Petersen et al., 2005). The benefits of supplier integration in NPD include better quality, reduced manufacturing costs, improved innovativeness and reduced time-to-market (see Table 6.1). Despite its benefits, this form of supplier integration also involves significant costs, resource requirements and challenges (Perols et al., 2013; Salvador and Villena, 2013) that may account for mixed findings offered by the literature about its effects on buyer performance (Primo and Amundson, 2002). Several empirical studies either find no evidence of such positive effects (e.g. Koufteros et al., 2005) or show that they are contingent on other factors (e.g. Ragatz et al., 2002; Wagner, 2011). We opt for the former arguments and posit that:

HP2: Supplier involvement in NPD has a positive effect on (a) efficiency and (b) innovation.

Operational coordination concerns the coordination of day-to-day activities in which the buyer's supply chain personnel and the supplier's operations managers interact around operational planning and process execution (Turkulainen and Swink, 2017). As it emerges from Table 6.1, even if the empirical evidence for the performance benefits of coordination has been inconsistent (e.g., Flynn et al., 2010), the majority of studies suggests that coordination improves not only operational, but also innovation performance. Thus:

HP3: Operational coordination has a positive effect on (a) efficiency and (b) innovation.

IT integration includes shared interorganizational systems, such as EDI, and other technologies for Business-To-Business communication, like the internet (Prajogo and Olhager, 2012). The use of IT for collaboration is important because it increases the volume and complexity of information that can be quickly exchanged with supply chain partners (Vickery et al., 2003; Prajogo and Olhager, 2012). In this paper, we focus on the use of e-business technologies, defined as Internet-based information systems used to acquire, process and transmit information for more effective decision-making (Devaraj et al., 2007; Wiengarten et al., 2013). Our choice is linked to the opportunities created by Internet-based applications to manage supplier relationships (Da Silveira and Cagliano, 2006) and to their numerous advantages compared to the classic technologies, such as EDI, namely lower transaction costs, wider interoperability and open-standard settings (Rabinovich et al., 2003; Da Silveira and Cagliano, 2006; Sanders, 2007). While some studies shown in Table 6.1 develop clear evidence of the benefits of IT integration, others show that these technologies have no significant effect on performance (e.g. Devaraj et al., 2007). Since most authors report positive effects, we hypothesize that:

HP4: IT integration has a positive effect on (a) efficiency and (b) innovation.

Table 6.1 Relevant literature on the supplier integration-performance relationship

SI type	Reference paper	Research findings
Supplier development	Krause et al. (2007)	Supplier development has a positive effect on quality, delivery and flexibility, but not on product cost.
	Li et al. (2007)	Supplier development efforts are classified into asset specificity, joint action, performance expectation and trust. Each effort has a different effect on buyer's performance: joint action and trust enhance operational effectiveness, asset specificity improves market responsiveness, while performance expectation does not impact on performance.
	Wagner (2011)	The effect of supplier development activities on buyer's performance (including reliability, time-to-market, production downtimes, customer satisfaction, quality, reliability and innovation) is moderated by relationship life-cycle: it is stronger in mature than in initial or declining life-cycle phases.
	Li et al. (2012)	Transaction-specific supplier development has positive effects on improvements in supplier performance, buyer-supplier relationship and buyer's competitive advantage (including cost, quality, speed, responsiveness and sales).

Table 6.1 (continued)

SI type	Reference paper	Research findings
Supplier involvement in NPD	Ragatz et al. (2002)	Supplier involvement in NPD, conceptualized with three sub-dimensions (need and alignment, integrative strategies and team processes), has a positive effect on cost, quality and cycle time.
	Petersen et al. (2003)	Supplier involvement on NPD teams results into a higher achievement of NPD project goals.
	Koufteros et al. (2005)	Supplier involvement in NPD has no significant effects on product innovation and quality. Uncertainty and platform strategy do not moderate the above relationships, while equivocality does: supplier integration has a positive effect on product innovation only in low equivocality environments and a negative effect on quality in high equivocality environments.
	Koufteros et al. (2010)	Supplier integration in NPD reduces glitches and has a positive effect on timely execution of engineering changes.
	Peng et al. (2013)	Supplier integration in NPD is positively associated with plant improvement and innovation capability. Contrary to the expectations, product clockspeed (i.e. the rate of new product introductions) does not moderate the mentioned relationships.
	Perols et al. (2013)	Supplier integration in NPD reduces time-to-market. This relationship is partially mediated by external technology adoption.
	Salvador and Villena (2013)	Supplier integration in NPD has a positive effect on unit cost of manufacturing, but no effect on product technical performance. Modular design competence moderates the relationships between supplier integration in NPD and both the analyzed performance dimensions. In addition, the moderation effects of modular design competence on the relation between supplier integration and unit cost of manufacturing is stronger when the NPD project is characterized by moderate levels of product and process innovation.
Operational coordination	Flynn et al. (2010)	Supplier integration is directly related neither to operational performance nor to business performance. The interaction of supplier integration with customer integration has a positive effect only on operational performance, while that with internal integration has no effect on performance.
	Wong et al. (2011)	Supplier integration is positively and significantly related to delivery, production cost, product quality and production flexibility. Under high environmental uncertainty, the effect of supplier integration on delivery and flexibility is strengthened.
	Prajogo et al. (2016)	The effect of supply logistics integration on competitive performance is not direct, but fully mediated by inbound supply performance and lean production processes.
	Wiengarten et al. (2016)	Supplier integration has a positive effect on cost and innovation performance. In addition, some moderation effects emerge: SI has a positive influence on cost and innovation performance when the rule of law is low (high risk) and companies have implemented supply chain risk practices; it has a negative influence on cost and innovation performance when the rule of law is high (low risk) and companies implement supply chain risk management practices.

Table 6.1 (continued)

SI type	Reference paper	Research findings
IT integration	Da Silveira and Cagliano (2006)	Interorganizational information systems are distinguished in dyadic, which support coordination between a few supply chain partners, and multilateral, which allow to communicate with a larger number of partners. The former systems are positively related to improvements in cost, delivery and quality, while the latter are positively elated to improvements in flexibility and quality.
	Devaraj et al. (2007)	There is no direct effect of e-business technologies on operational performance; this effect is mediated by production information integration.
	Sanders (2007)	The effect of e-business technologies on organizational performance (expressed in terms of cost, quality, delivery speed and new product introduction time) is both direct and indirect through intra and inter-organizational collaboration.
	Wiengarten et al. (2013)	E-business applications, defined as a multiple construct including interaction, coordination and integration applications, enable buyer-supplier collaboration and subsequently improve operational performance.

6.2.3 Moderating effects of supply base reduction

From the previous review, it emerges that the relationship between SI dimensions and performance is inconclusive. Thus, like other studies of supply chain integration (e.g. Flynn et al., 2010; Danese et al., 2013), we adopt a contingency approach in order to better understand the topic. The contingency theory (Lawrence and Lorsch, 1967; Thompson, 1967) argues that a specific strategy or tactic does not necessarily provide the same performance benefits in all contexts; it must be aligned with an appropriate organizational design (Flynn et al., 2010). We apply this underlying logic to study how the effects of supplier integration activities may be contingent upon supply network design choices. Certain aspects of supply networks are likely to be more or less complementary to the effects of supplier integration on buyer performance. Complementarity means that the marginal values of one variable are increasing with the level of another variable (Milgrom & Roberts, 1995) and thus the implementation of isolated practices is not as valuable as the synergies emerging from their specific arrangements (Danese, 2013). In this research, we posit that there are complementary effects between supplier integration and a supply network design choice, supply base reduction. In particular, considering all the aspects characterizing a reduced supply base, i.e., fewer communication channels, simplified coordination, stronger motivation, trust and dependence, we suggest that supply base reduction has a positive moderating effect on the relationships between supplier integration activities and performance. Indeed, the literature seems to suggest not only that the potential benefits of supplier integration are greater in environments characterized by reduced supply bases, but also that such context limits the risks that may hinder the positive effects of integration widely recognized in the literature.

First, supplier development requires huge resources and time to support suppliers in improving their competitive capabilities (Krause et al., 1998) and it is reasonable to hypothesize that these improvements increase with the efforts dedicated by customers to such activity. Assuming that these latter have a fixed amount of resources to invest in supplier development, a reduced supply base, compared to a more enlarged one, allows to dedicate more resources per supplier. This implies stronger performance improvements for suppliers and, consequently, a stronger effect of supplier development on buyer's performance. On the contrary, dispersing supplier development efforts on a large supply base may hinder its potential benefits. As pointed out by Krause and Ellram (1997), one of the biggest and most common pitfalls that companies encounter in their supplier development initiatives is the lack of commitment from one of the two sides. This situation is more likely to happen in a large than in a small supply base. Indeed, if a buyer purchases small quantities from numerous suppliers, none of them may be important enough to justify the often large investments required for its development, reducing the commitment to a potential improvement project from both parts (Handfield et al., 2000; Giannakis, 2008). Instead, if a company consolidates purchases to a limited number of suppliers, the interdependence and potential for benefit between the parties grows. Accordingly, we expect to observe stronger benefits from supplier development when this practice is developed in a context characterized by a reduced supply base:

HP5: A reduced supply base strengthens the positive effect of supplier development on (a) efficiency and (b) innovation.

Scholars highlighted the benefits of increased customer-supplier collaboration in NPD process, but also warned about the risks which include the possible (a) explosion of development times (Parker and Brey, 2015), (b) opportunistic supplier behaviors (Salvador and Villena, 2013), and (c) loss of control over valuable knowledge and information (Parker, 2012). These risks, which may hinder the positive effects of NPD collaboration, can be decreased with a reduction of the supply base. As underlined by Parker and Brey (2015), increased management costs plus possible stretching of times due to more intense alignment and information sharing can easily nullify efficiency improvements due to collaboration in NPD. In a reduced supply base, however, fewer suppliers need to be managed, and suppliers who are invited to participate in NPD are likely to make greater commitments of dedicated resources to the effort. Similarly, risks of lost proprietary control due to the sharing of sensitive information (Wasti and Liker, 1997) are also reduced, as more concentrated suppliers are likely to make more specific investments which tend to curb opportunism (Koufteros et al. 2007). In addition, single source suppliers or class-A suppliers have stronger vested interests in the success of the NPD project. They therefore are more likely to offer stronger commitment to innovation, and to maintaining secrecy of proprietary information. Interestingly enough, some authors recognize that also an increase of the supply base can positively moderate the impact of customer-supplier collaboration in NPD process on efficiency and innovation. Cooperate with a large number of suppliers in NPD activities can provide more opportunities not only to reduce costs, thanks to the different suppliers' inputs, but also to access specialized knowledge, avoiding the locked-in situations where the customers depend on their few suppliers and the related technologies (Swink and Zsidisin, 2006). However, this view occupies a minority position in the academic debate, thus we argue that the whole impact of supplier involvement in NPD on performance increases as the supply base reduces:

HP6: A reduced supply base strengthens the positive effect of supplier involvement in NPD on (a) efficiency and (b) innovation.

Operational coordination with suppliers concerns day-to-day activities in which partners share and discuss their production, inventory and delivery status and plans. Such type of integration, realized with fewer, more trusted suppliers, increases the quality and richness of data shared (Paulraj and Chen, 2005; Li and Lin, 2006), which in turn creates richer opportunities for process improvement (Liu et al., 2013). Instead, when the two parties are not strongly dependent (i.e. large supply base), the supplier may be led by conflicting interests, like gaining more volumes from the buyer, and the information it shares with its partner may consequently be ill-structured (Lu and Shang, 2017). Furthermore, given the lower trust levels in dispersed supply bases, the customers themselves may be reluctant to completely rely on their partner's data and information, hindering the potential benefits of collaboration. In addition, when a buyer collaborates with a limited number of suppliers, it is easier and more effective to communicate changes and needs to the partners, who are thus expected to respond quickly (Choi and Krause, 2006). This means that the operational planning and scheduling can be adapted easier, faster and with lower costs, maximizing the benefits of supplier integration.

Turkulainen and Swink (2017) provide empirical evidence that information gained from operational coordination better equips internal supply chain managers to support innovation within their firms. They suggest that supply managers glean valuable market and technology information from their day-to-day operational interactions with suppliers. We expect that such learning is more likely in interactions with trusted, more dedicated partners. It should be noted that also an opposite argument could held: operational interactions with a larger set of suppliers increase the breadth of scanning that supply managers can conduct, as well as the diversity of information sources they consult with positive effects on innovativeness. Being this view not supported by literature, we opt for the former argument and posit that a reduced supply base improves the effectiveness of operational integration for both efficiency and innovation.

HP7: A reduced supply base strengthens the positive effect of operational coordination on (a) efficiency and (b) innovation.

Where the foregoing three hypotheses address different goals and levels of integration, our last hypothesis addresses the medium of integration. The possibility to exchange real-time information, of both operational and strategic (e.g. NPD) nature, through e-business technologies may bring companies to send continuous updates to the partners and this can be beneficial for performance. However, it is reasonable to assume that these benefits increase in reduced supply bases, when the actors involved, and the information shared are limited. Vachon and Klassen (2002) observed that the higher the number of suppliers, the higher the cost and time required to combine all information and to obtain consistent inputs. This can limit the positive effects of IT integration on efficiency and product development time. In addition, the exchanges of information with suppliers realized through e-business technologies can create heavy information processing loads and we can expect that the total transaction load of such activity increases with supply base size. While it is true that e-business technologies can be used to automate and standardize information processing, providing the basis for the so-called mass collaboration (Chen et al., 2007), it is also important to underline that implementing e-business technologies is increasingly costly with increasing numbers of partners to be connected (Rabinovich et al., 2003).
Considering all the above aspects, we hypothesize that:

HP8: A reduced supply base strengthens the positive effect of IT integration on (a) efficiency and (b) innovation.

6.3 Research methodology

6.3.1 Sample and data collection

The study uses data from the fourth round of the High Performance Manufacturing (HPM) project data set. These data, which were collected by a team of international researchers operating in different countries, include responses from manufacturing plants belonging to the mechanical, electronics and transportation equipment sectors (SIC codes: 35, 36 and 37, respectively) and located in 15 different countries (i.e. Brazil, Germany, Spain, Israel, Sweden, Italy, Japan, China, Korea, Finland, Taiwan, United Kingdom, Vietnam, US and Switzerland). The plants were randomly selected from a master list of manufacturing plants in each of the countries, with the constraint of representing different parent corporations and having at least 100 employees.

As concerns data collection, each local team was in charge of selecting plants and collecting data in each of the above countries. After the evaluation of the plant CEO's intention to participate in the HPM research project, a batch of questionnaires, targeted at the respondents who were the best informed about the topic of the specific questionnaire, was sent to the participating plants. In particular, researchers involved in the HPM project asked the CEOs to provide the respondents' name and contact address, as well as to distribute the questionnaires to the respondents by visit or by post. Each local HPM research team had to provide assistance to the respondents, to ensure that the information gathered was both complete and correct. In total, 20 recipients were involved in each plant (i.e., plant accounting manager, direct labors, human resource manager, information systems manager, production control manager, inventory manager, members of the new product development team, process engineer, plant manager, quality manager, supervisors, plant superintendent) and some of them filled out more than one questionnaire. Thus, with the aim to reduce the problem of common method bias and raise measurement reliability, each questionnaire was administered to different respondents within each plant. To conduct plant level analysis, individual responses for each item were then aggregated by taking the average of within-plant responses. Finally, to increase the response rate, the questionnaires were originally developed in English and then translated into the local language by a local member of the team. They were then back-translated into English by a different local team member to assure accuracy in translation.

The items used in this research were targeted to plant managers, upstream supply chain managers and new product development managers or their immediate subordinates working in direct contact with suppliers. Respondents had to give answers about the supplier integration practices implemented in the plant, about the supply network design and performance achieved. Since the questionnaire is based on multiple responses, it is important to follow the recommendations of Boyer and Verma (2000), who suggest checking the inter-rater agreement by measuring the Interclass Correlation (ICC) index. The ICC indexes resulted above 0.70 for each item, indicating an acceptable agreement among different informants within a plant.

The HPM dataset includes 330 plants, but 6 were excluded from the study because they included incomplete responses on the selected items. As a result, 324 plants were used as a sample to realize all the analyses. Table 6.2 provides an overview of our sample in terms of industry and country.

Table 6.2 Sample characteristics

		Industry			
		Electronics	Machinery	Transportation	**Total**
Country	Brazil	5	7	12	24
	Germany	6	12	9	27
	Spain	7	7	10	24
	Israel	17	5	0	22
	Sweden	4	4	1	9
	Italy	7	17	5	29
	Japan	6	7	9	22
	China	10	17	3	30
	Korea	8	5	13	26
	Finland	6	6	5	17
	Taiwan	19	10	1	30
	United Kingdom	4	5	4	13
	Vietnam	10	7	8	25
	US	5	7	3	15
	Switzerland	3	6	2	11
Total		117	122	85	324

6.3.2 Measures

This research includes several multi-item constructs that were developed based on the literature review of conceptual studies as well as empirical studies in the relevant areas. All the items were measured using perceptual scales with values ranging from 1 to 5, indicating complete disagreements and complete agreements to the proposed statements. The complete list of the measurement scales is displayed in Table 6.3.

Supplier development includes five items measuring the extent to which the focal company provides assistance and training to its suppliers. A similar operationalization has been used by Lo et al. (2018) and Turkulainen et al. (2017). Supplier involvement in NPD is instead a four-items scale considering the degree of interactions with suppliers in the design of new products and it was adopted by Peng et al. (2014) and Garrido-Vega et al. (2015). Operational coordination includes three items that address coordination between buyer and supplier to achieve efficient task execution. The same scale was adopted by Sanders (2008), even if it was measured from the perspective of the supplier. Three items were used to evaluate the adoption of e-business technologies to share information with suppliers. This scale was adapted from Wu et al. (2003). As regards the dimension of the supply base, we used a 4-items scale adapted from Chen and Paulraj (2004) that measures the extent to which a company relies on a small number of suppliers. For this reason, we labelled this scale “supply base reduction”. Efficiency was evaluated using a five-items scale, adapted from Danese and Bortolotti (2014), Wiengarten et al. (2016) and Alfalla-Luque et al. (2018), while innovation was measured with two items, as in Sanders Jones and Linderman (2014). For these two performance dimensions, respondents were asked to provide their opinion about plant's performances compared with competitors on a five-point Likert scale (1 is for 'poor' and 5 is for 'superior').

Finally, we adopted six control variables: industry, country, firm size, purchasing department size, investments in R&D and supplier selection based on supplier's capabilities. Industry was included in the analyses by creating two dummy variables and the transportation sector was arbitrarily taken as the baseline/comparison group. To control for country differences, we grouped sample firms into three categories: Asia, America and Europe, using the latter as baseline/comparison group. Size was measured as the total number of personnel employed and was included as control variable because it may influence the amount of available resource, which in turn can affect performance. The purchasing department size was calculated dividing the number of people employed in the purchasing department by the total number of personnel employed. It can be considered a proxy of the costs of integration, since as the latter increases, also the resources required to manage all the interactions with suppliers increase. To correct for the skewness of the data, the natural log of both size and purchasing department size was used. Finally, both Investments in R&D and supplier selection based on supplier's capabilities were measured using a five-point scale. The former refers to the percentage of sales spent in R&D compared to the leading competitors, while the latter evaluates the importance given to supplier's capabilities during the selection process (see Table 6.3).

Table 6.3 Measurement items

Construct	**Standardized factor loading**	**Cronbach's α**	**CR**
Supplier development (DEV)		0.77	0.78
Please indicate your opinion on the following statements, referring to your plant:			
We provide our suppliers with sufficient technical assistance.	0.56		
We encourage our suppliers to continuously improve their production processes.	0.66		
We offer the necessary training to our suppliers.	0.68		
We share our vision and supply chain policy with our key suppliers.	0.66		
As our suppliers strive to improve their processes, we provide assistance.	0.65		
Supplier involvement in NPD (INV)		0.85	0.85
Please indicate your opinion on the following statements related to new product development projects, referring to your plant:			
Suppliers are involved early in product design efforts.	0.85		
We partner with suppliers for the design of new products.	0.79		
Suppliers are frequently consulted during the design of new products.	0.73		
Suppliers are an integral part of new product design efforts.	0.69		

Table 6.3 (continued)

Construct	Standardized factor loading	Cronbach's α	CR
Operational coordination (OPC)		0.82	0.82
Please indicate the extent of involvement of your plant in the following activities with your primary suppliers:			
Sharing operational information	0.75		
Coordination of production planning	0.81		
Utilization of integrated database for information sharing	0.77		
IT integration (ITI)		0.83	0.83
To what extent does your plant use e-business tools to reach the following goals?			
Send suppliers regular updates about new product plans and other new developments (e.g., via email)	0.70		
Provide specific online information about product specifications that our suppliers must meet	0.77		
Share product and inventory planning information with our suppliers	0.89		
Supply base reduction (SBR)		0.68	0.69
Please indicate your opinion on the following statements, referring to your plant:			
We rely on a small number of high quality suppliers.	0.61		
We maintain a close relationship with a limited pool of suppliers.	0.55		
Our supply base is quite small, compared with our competitors.	0.50		
We try to keep our supply base small.	0.71		
Efficiency (EFF)		0.85	0.85
Please circle the number that indicates your opinion about how your plant compares to its competitors in its industry, on a global basis.			
Unit cost of manufacturing	0.71		
Labor cost	0.73		
Labor productivity	0.68		
Throughput: the rate at which the plant generates money through sales	0.67		
Inventory: raw materials, work-in-process and finished goods	0.65		
Operating expense: funds spent to generate turnover, including direct labor, indirect labor, rent, utility expenses and depreciation	0.73		
Innovation (INN)		0.72	0.74
Please circle the number that indicates your opinion about how your plant compares to its competitors in its industry, on a global basis.			
On time new product launch	0.91		
Product innovativeness	0.61		

Table 6.3 (continued)

Construct	Standardized factor loading	Cronbach's α	CR
Supplier selection		0.79	0.81
How important is each of the following criteria in the selection of key suppliers for this plant?			
Design capability	0.61		
Ideas and suggestions from suppliers	0.55		
Technical skill	0.84		
Technological capabilities	0.87		

6.3.3 Reliability and validity

Confirmatory factor analysis (CFA) was run to assess the reliability and validity of our constructs, using LISREL 8.80 software. Considering the indications of Hair et al. (2006), the results indicate overall good model fit and thus suggest no changes to the specified structure (χ^2 = 819.86; df = 406; χ^2/df=2.019; RMSEA = 0.055 [0.0495;0.0606]; CFI = 0.951; NFI = 0.91; TLI = 0.94). Convergent validity was assessed analyzing the standardized parameter loadings of the measurement items on their respective constructs. All the factor loadings exceed 0.50 and are statistically significant, providing support for convergent validity (see Table 6.3). As concerns reliability, composite reliabilities (CR) of multi-item scales are above the recommended threshold of 0.70 (Hair et al., 2006), with the exception of supply base reduction that however is still above the acceptable cut-off point of 0.60 (Nunnally & Bernstein, 1994). Finally, the square root of the average variance extracted (AVE) for each construct is larger than the correlation coefficient between that construct and all the other constructs, as suggested by Fornell and Larcker (1981), providing evidence of discriminant validity. We also build a CFA model with every possible pair of latent constructs and the correlations between the paired constructs set to 1.0. The results of the comparison, based on χ^2 differences, between these models and the original model provides an additional support to discriminant validity (Bagozzi et al., 1991; Flynn et al., 2010). Table 6.4 provides the basic statistics and correlation for the constructs included in the analysis.

Table 6.4 Summary statistics and correlations

	Mean	SD	1	2	3	4	5	6	7	8
1. Supplier development	3.85	0.62	0.64							
2. Supplier involvement in NPD	3.70	0.74	0.33*	0.77						
3. Operational coordination	2.95	0.86	0.44*	0.18*	0.78					
4. IT integration	3.01	0.97	0.39*	0.14*	0.60*	0.79				
5. Supply base reduction	3.50	0.67	0.44*	0.14*	0.24*	0.22*	0.60			
6. Efficiency	3.39	0.64	0.23*	0.29*	0.22*	0.08	0.068	0.70		
7. Innovation	3.64	0.75	0.19*	0.20*	0.16*	0.16*	0.15*	0.50*	0.78	
8. Supplier selection	4.13	0.53	0.54*	0.28*	0.27*	0.23*	0.24*	0.22*	0.20*	0.73

** Significant at the 0.01 level (Pearson probabilities).*
Note: the square-root of the average variance extracted (AVE) is printed on the diagonal.

6.4 Results

We ran hierarchical regression analysis to test our hypotheses, by using SPSS 15.0. The moderation hypotheses were tested using interaction terms, calculated as products between supply base reduction and the four supplier integration variables. Before computing the products, we mean-centered all the independent variables to address the effects of potential multicollinearity, as suggested by Jaccard and Turrisi (2003).

The analyses consisted of three steps. First, the control variables were included in the regression models to control for their potential effects (Model 0 in Tables 6.5 and 6.6). Then, the independent variables were added in the equation as a block to examine their main effects on efficiency and innovation (Model 1 in Tables 6.5 and 6.6). Finally, to test the moderation hypotheses, each interaction term was entered individually and removed before the following was introduced (Models 2, 3, 4 and 5 in Tables 6.5 and 6.6). This approach was adopted to minimize multicollinearity that can occur when a variable is included in different interaction terms (Parthasarthy and Hammond, 2002; Danese et al., 2013). To further assess the multicollinearity problem, we also checked the variance inflation factors (VIFs), whose maximum value, 2.11, was well below the recommended threshold. As suggested by Jaccard and Turrisi (2003), the existence of a moderation effects is proved when the β-coefficient of the interaction term is statistically significant and R^2 increases when the term is included in the model.

As it emerges from Tables 6.5 and 6.6, the set of hypotheses is partially supported. As regards the direct effects of supplier integration activities, the results show that only supplier involvement in NPD has a positive significant effect on efficiency, supporting HP2a. Supplier development and operational coordination have a not significant association with efficiency, while the effect of IT integration on efficiency is significant but negative, thus rejecting HP1a, HP3a and HP4a. In addition, supplier involvement in NPD is the only activity showing a significant positive effect also on innovation (HP2b). All the other hypotheses related to innovation (i.e. HP1b, HP3b and HP4b) are not supported. Looking to the moderation hypotheses, it emerges that supply base reduction positively moderates the relationships between supplier development and both efficiency (HP1a) and innovation (HP1b), between supplier involvement in NPD and efficiency (HP2a), between operational coordination and both efficiency (HP3a) and innovation (HP3b), between IT integration and efficiency (HP4a). No support is instead found for the moderating effect of supply base reduction on the relationships between supplier involvement in NPD and innovation (HP2b) and between IT integration and innovation (HP4b).

Table 6.5 Regression analysis results for efficiency (unstandardized coefficients)

	Control variables	**Main effects**	**Interaction effects**			
	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	2,84**	2,91**	2,84**	2,86**	2,85**	2,88**
Electronics	-0,14	-0,10	-0,12	-0,11	-0,11	-0,10
Machinery	-0,15^{+}	-0,12	-0,13	-0,13	-0,14^{+}	-0,13
Asia	0,38**	0,33**	0,34**	0,33**	0,33**	0,33**
America	0,21*	0,18^{+}	0,18^{+}	0,17	0,16	0,19^{+}
Firm size	0,07*	0,06^{+}	0,07*	0,07*	0,07*	0,07*
Purch. dep. size	-0,01	0,00	0,01	-0,01	-0,01	0,00
Investments in R&D	0,20**	0,20**	0,19**	0,19**	0,20**	0,20**
Supplier selection	0,20**	0,12^{+}	0,09	0,11	0,09	0,10
DEV		0,07	0,13^{+}	0,08	0,09	0,09
INV		0,10*	0,10*	0,11*	0,09^{+}	0,10*
OPC		0,08	0,07	0,07	0,08	0,07
ITI		-0,10*	-0,10*	-0,10*	-0,11**	-0,10*
SBR		0,01	0,00	-0,02	0,02	0,00
DEVxSBR			0,24**			
INVxSBR				0,13*		
OPCxSBR					0,11*	
ITIxSBR						0,09^{+}
R^2	0.25	0.28	0.31	0.29	0.29	0.29
ΔR^2	-	0.03	0.03	0.01	0.01	0.01
F change	12.78**	2.62*	14.64**	4.65*	5.37*	3.64^{+}

$^{+}p < .10$; $^{*}p < .05$; $^{**}p < .01$.

Table 6.6 Regression analysis results for innovation (unstandardized coefficients)

	Control variables	**Main effects**	**Interaction effects**			
	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	3,58**	3,62**	3,55**	3,58**	3,53**	3,60**
Electronics	-0,17^{+}	-0,17	-0,20^{+}	-0,18^{+}	-0,18^{+}	-0,17
Machinery	-0,27**	-0,23*	-0,24*	-0,24*	-0,26*	-0,24*
Asia	-0,01	-0,03	-0,03	-0,03	-0,04	-0,04
America	0,13	0,13	0,13	0,13	0,11	0,14
Firm size	0,01	0,01	0,02	0,01	0,02	0,01
Purch. dep. size	-0,04	-0,03	-0,03	-0,04	-0,04	-0,03
Investments in R&D	0,24**	0,22**	0,21**	0,21**	0,22**	0,22**
Supplier selection	0,23**	0,14	0,10	0,13	0,09	0,12
DEV		0,05	0,11	0,06	0,08	0,07
INV		0,10^{+}	0,09	0,11^{+}	0,08	0,09
OPC		-0,02	-0,03	-0,02	-0,02	-0,02
ITI		0,02	0,03	0,02	0,01	0,02
SBR		0,09	0,07	0,06	0,09	0,08
DEVxSBR			0,27**			
INVxSBR				0,12		
OPCxSBR					0,18**	
ITIxSBR						0,06
R^2	0.15	0.17	0.20	0.18	0.19	0.17
ΔR^2	0.15	0.02	0.03	0.01	0.02	0.00
F change	6.94**	1.43	11.70**	2.25	8.86**	1.31

$^{+}p < .10$; $^{*}p < .05$; $^{**}p < .01$.

As suggested by many authors (Jaccard and Turrisi, 2003; Brambor et al., 2006), we also calculated the marginal effect of each supplier integration dimension on both efficiency and innovation using equation (1) (where Y is the dependent variable, i.e. performance, X is the independent variable, i.e. supplier integration, and Z is the moderator, i.e. supply base reduction):

$$\frac{\partial Y}{\partial X} = \beta_1 + \beta_3 Z$$

The significance of the marginal effect depends on standard error of the right side of equation 1 that is function of the moderator, supply base reduction. Using t-tests we identified the range of SBR values where the marginal effect is significant at 0.05 level. This information has been useful to better interpret the impact of supplier integration activities on efficiency and innovation at different levels of supply base reduction (see Figure 6.1). Following the suggestions of Cohen and Cohen (1983), we plotted this impact in two distinct contexts: one standard deviation below the mean score of supply base reduction ("low supply base reduction") and one standard deviation above ("high supply base reduction").

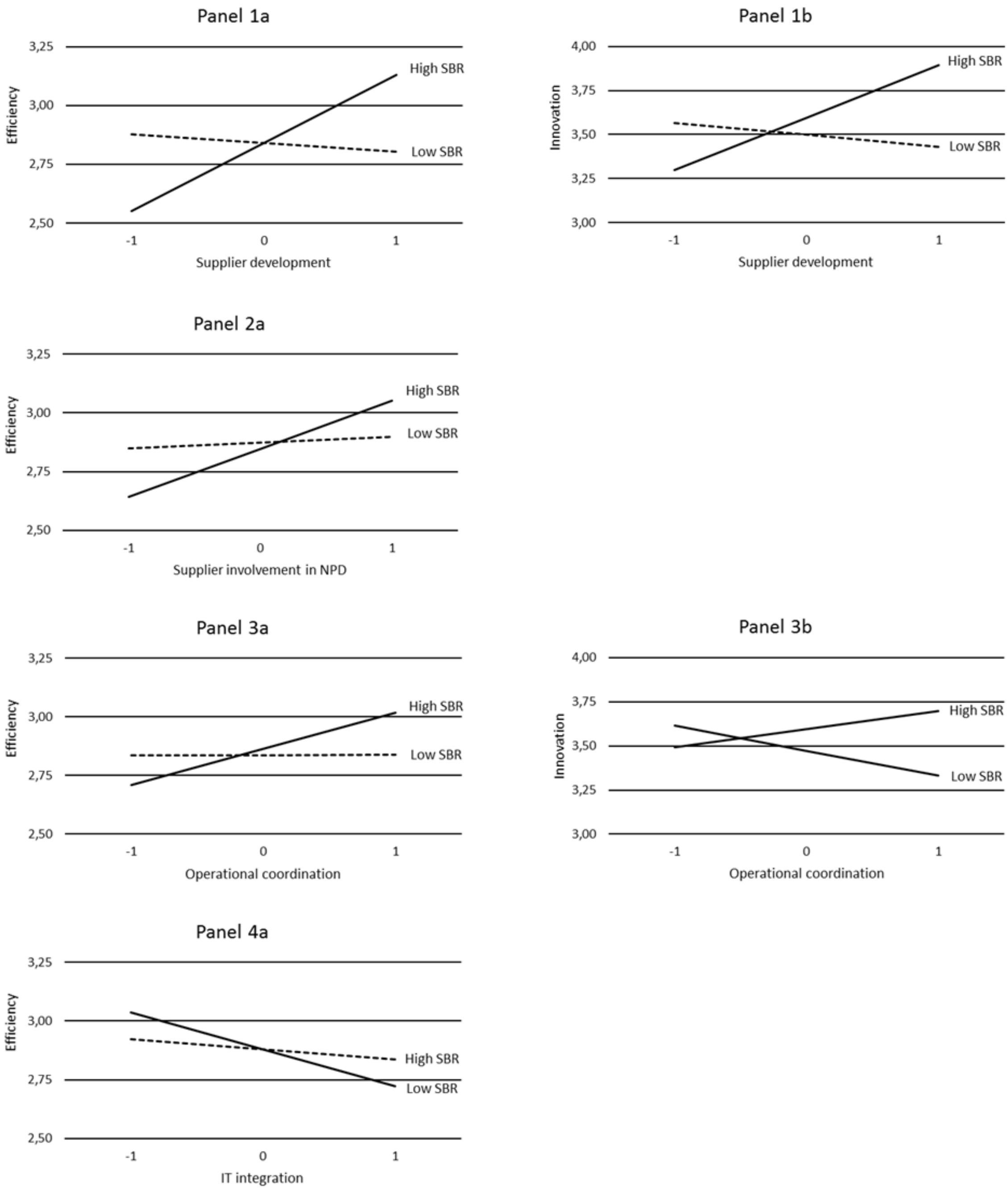

Figure 6.1 Efficiency and innovation slopes at low and high levels of supply base reduction (only significant interactions)

Note: a dashed line indicates that the marginal effect (curve slope) is not significant at 0.05 level

The six Panels of Figure 6.1 show that the effect of supplier integration on efficiency and innovation is amplified when supply base reduction increases (complementary effect), while it is almost nullified and, in some cases, even negative when reduction is at low level (barrier effect). This situation highlights what Jaccard and Turrisi (2003) classify as “crossover interaction”, a particular type of disordinal interaction, where the line that regresses a dependent variable (e.g. efficiency) onto the focal independent variable (e.g. supplier development) for a given level of the moderator (e.g. low level of supply base reduction) intersects with the corresponding regression line for a different level of the moderator (e.g. high level of supply base reduction). This type of interaction generates interesting insights. For instance, it suggests that high levels of supplier integration activities are more effective when the company relies on a small supply base, while below a certain level of integration, that varies according to the type of supplier integration considered, a larger supply base seems to be more appropriate. This finding stresses the importance of ensuring a proper fit between supplier integration and the dimension of the supply base.

6.5 Discussion

This study provides contributions and novel insights to the SCI research in a number of ways.

First of all, the analyses advance our knowledge on the direct effect of supplier integration on performance. The research findings are only partially in line with the literature. Indeed, although we hypothesized positive relations between supplier integration and performance, it emerges that the effect of some SI dimensions is not significant and, in some cases, even negative. As concerns supplier involvement in NPD, our results confirm the literature supporting its positive effects on efficiency and innovation. As underlined by many scholars, sharing ideas and information with suppliers and working with them in the early stages of the design cycle allows to quickly identify potential mistakes and problems, thus improving innovativeness (Peng et al., 2013) and reducing cost (Ragatz et al., 2002) and time-to-market (Perols et al., 2013). As regards instead supplier development, it emerges that, contrary to our expectations, its effect on both efficiency and innovation is not significant. These results are however not surprising, since some scholars already questioned the effective benefits of this integration form (e.g. Krause et al., 2007). In fact, since supplier development could be further classified into different activities, each of which may have different effects on performance (see Li et al. (2007)), it is reasonable to assume that the activities required to improve efficiency are different from that required for innovation. For instance, Krause et al. (2007) claim that “direct involvement” activities of supplier development, like regular visits to suppliers, creation of supplier development teams etc., create an environment that facilitates transfer of tacit knowledge and learning. This type of supplier development could be the right solution to improve innovation, but maybe not efficiency. Similarly, a support for the improvement of suppliers’ processes may be more beneficial for efficiency than for innovation. The construct used in our research measures an average and general level of investments in supplier development, including different activities, and this has probably caused the loss of significance for both performance dimensions. Future research should go more deeply into these aspects, identifying different supplier development activities and testing their potential different effect on efficiency and innovation. A not significant association with the performance dimensions considered in our study is found also for operational coordination with suppliers. The idea that operational coordination may not be beneficial for operational performance has already been proposed by other scholars, like Frohlich and Westbrook (2001) and Flynn et al. (2010). Our results on efficiency can thus be considered in line with this stream of the literature. As regards instead innovation, we believe that the not significant association is linked to the fact that accessing supplier knowledge during the operational interactions is not enough if the involved personnel is not able to transfer this knowledge inside the company. This view supports the results of Turkulainen and Swink (2017), who underline the importance of involving internal supply chain personnel in innovation activities when the company implements supplier operational integration. Finally, as concerns IT integration, the results are more surprising since our findings show a not significant effect on innovation and even a negative one on efficiency. The lack of a direct effect of e-business technologies on performance was already discussed by Devaraj et al. (2007), who emphasize that having a capability is useless if the company does not have the right processes in place to leverage that capability. However, the negative effect found in our analysis is, according to our knowledge, new in the SCI research, but not in other fields of the literature. We refer to the so-called productivity paradox, a phenomenon indicating a lack or even a decrease of productivity as a result of IT investments at the country as well as the firm level (Solow, 1987). This topic has been widely studied by scholars and the existence of the productivity paradox, despite its old roots, is supported also by some recent publications (Acemoglu et al., 2014; Kim et al., 2015; Polák, 2017). The reference to this phenomenon is important because some of the explanations for its existence, and in particular the mismanagement of IT solutions, can be easily be transferred to the SCI literature. Indeed, as claimed by Brynjolfsson (1993) and Polák (2017), managers are easily influenced by transitory common believes that a certain technology is new and efficient, and they consequently do inappropriate investments in IT or do not accompany them by proper organizations, processes and incentives. The result is the development of inefficient systems and the creation of slack instead of efficiency. This is what may happen also in the context of SCI. Companies belonging to our sample may have introduced e-business technologies to share information without the development of proper organizational capabilities to process the information received. It may also be that the information shared led to a misunderstanding between the partners. For instance, the supplier may adapt its production according to the inventory data received by the customer, but the impossibility of knowing the effective use of the customer's stocked items can led the supplier to make choices that, among other things, result in a loss of buyer's efficiency. This indicates the need to complement information sharing with other collaborative practices to benefit from IT. Finally, there can be also more technological problems, like the difficulty of integrating e-business systems with company's ones. If the information received does not directly fit into the partner's information systems, as it often happens with e-business technologies, it is more difficult and time-consuming to use the information transmitted, especially when the load is high. The general idea is that thanks to the IT solutions offered nowadays, an increasing amount of information, data and details can be shared, but this implies also greater possibility of errors and, consequently, negative effects on performance. Obviously, future research should deepen these aspects to corroborate the results and provide additional information to explain them.

The second and biggest contribution of this research is related to the contextual factors influencing the relationship between supplier integration and performance. The research findings support most of our hypotheses and the related theory regarding the contingent role of supply base reduction for supplier integration success and such a result, based on a large sample of companies, is novel in the literature. Some studies already confirmed the existence of complementary effects between supplier integration and supply base size, like Vanpoucke et al. (2014) and Golini and Kalchschmidt (2015). The former proposes a "supplier integrative capabilities" construct that includes different supplier integration activities and shows that its impact on cost efficiency and process flexibility is weakened as the number of key suppliers increases. The latter instead maintains that supply management activities, including both operational and strategic supplier integration practices, are associated with lowered inventories only when the number of suppliers is limited. Our study extends these results and provides several original contributions to the SCI research not only by including innovation as an additional dependent variable, but also by distinguishing the effects of different supplier integration dimensions.

As regards efficiency, the analyses indicate that the effectiveness of both strategic and operational supplier integration activities is stronger when the supply base has been reduced. These results are in line with the expectations and with the related literature. Developing suppliers and involving them in NPD activities is more efficient in a reduced supply base because the parties are more interdependent (Koufteros et al., 2007) and their coordination is simplified (Ates et al., 2015). In addition, as underlined by Choi and Krause (2006), in a reduced supply base there are less interfaces to be managed and so communicating with suppliers and coordinating the operational activities with them is cheaper and easier. Looking at Panels 1a, 2a and 3a in Figure 6.1, it is easy to see not only that when companies interact with a reduced supply base the benefits of different supplier integration activities are strengthened, but also that, in absence of such network structure (i.e. large supply bases), any attempt to increase the benefits of supplier integration may be useless. However, these results should be taken with caution because the dashed lines relating to a low SBR are characterized by a non-significant marginal effect of SI on efficiency. Therefore, future research should investigate more in-depth the effect of SI on efficiency when the SBR is at a very low level.

An interesting result related to efficiency is offered by the IT integration. As shown in Panel 4a (Figure 6.1), the positive moderation of supply base reduction is confirmed, but with a different effect from what we expected. Indeed, it seems that SBR reduces the negative effects of IT integration, instead of strengthening the hypothesized positive ones. This may be due not only to the relatively high costs of implementation of these technologies (Rabinovich et al., 2003), but also to the difficulties that companies encounter in receiving, using and communicating information when the number of suppliers to be involved is high. In other words, the previously discussed problems that may arise with IT integration are particularly evident in large supply bases. Managers should thus pay attention to their investments for IT-based integration because, even if some researches underline that mass collaboration provides significant benefits to companies (Chen et al., 2007), the risk faced with a large supply base is to obtain negative effects on efficiency.

As for innovation, the effects of supplier development are again stronger in smaller supply bases, as we previously hypothesized. Several authors already associated supplier development activities to supply base reduction (e.g. Choi and Krause, 2006) and some of them also included the two activities into a single construct of supply management practices (e.g. Gualandris et al., 2014). With this study, we confirm, with a quantitative analysis, the general idea widespread in the literature that in order to develop effective supplier development programs, it is necessary to reduce the number of suppliers. As regards operational coordination (Panel 3b in Figure 6.1), while in a reduced supply base operational integration is beneficial for efficiency, its effect becomes negative when the buyer's supply base is larger. We provide the following explanation. Operational coordination allows to improve innovation because the buyer can access supplier's knowledge during the interactions between the parties aimed at coordinating the operational activities (Schoenherr and Swink, 2015). On one hand, as the number of suppliers increases, the feedbacks and the ideas collected during the face-to-face interactions with these partners increase as well, but so does also the risk to receive misaligned opinions and suggestions for new products. Therefore, it becomes more difficult and time consuming for the buyer to manage and internalize such knowledge, with the risk of losing all the related benefits. On the other hand, the problems linked to the lower trust characterizing a larger supply base may also emerge. We already discussed this issue in Section 2. If the parties are not interdependent, the buyer may be reluctant to rely on supplier's knowledge and, at the same time, the supplier may be led by conflicting interests and thus alter the information shared, negatively affecting innovation. The situation is different for supplier involvement in NPD, whose positive effect on innovation is independent from supply base size. The different result, compared to that of operational coordination, is probably due to the different ways in which the two integration forms can improve innovation. While in the operational coordination the buyer typically interfaces with its suppliers in separated sessions and must thus manage them and the ideas collected independently, in NPD involvement the buyer may create specific transversal teams dedicated to specific NPD projects and involving representatives from different supply companies. Thus, in the latter case, the buyer does not need to act as a collector of information that must then be shared and transferred to the other partners, but all the companies directly work together to a common NPD project, with a consequent positive effect on both innovativeness and on-time launch also in a large supply base. Finally, the results show that the relationship between the use of e-business technologies with suppliers and innovation is not moderated by supply base reduction. Since this form of IT integration has also a not significant main effect on innovation, we can conclude that although it can be used to share data on NPD plans and their execution, this does not lead to any tangible improvements in term of product innovativeness or on-time new product launch. Probably, direct and face-to-face collaborative activities, like strategic or operational supplier integration, are needed to improve this performance dimension.

The last contribution of this paper is related to the stream of the literature dealing with single versus multiple sourcing decisions. As we already underlined in the previous sections, the selection of the most appropriate sourcing policy is not easy for companies because they have to carefully evaluate the trade-offs between reduced and enlarged supply bases. In order to help managers in the identification of the most suitable supply base size, several papers in the literature have discussed the existence of different factors that affect the effectiveness of sourcing policies and that must consequently be taken into consideration for supply network design choices. Some examples are supplier's capacity (Burke et al., 2007), buyer's bargaining power (Heese, 2015), task modularity, performance metrics-project revenue alignment and verifiability of project revenue (Bhattacharya et al., 2018). With this research, we show that the level of supplier integration is another element that interacts with supply base size to improve efficiency and innovation. Indeed, as shown by Figure 6.1 and excluding the case of IT integration, it is evident that, when companies do not develop supplier integration initiatives, a large supply base provides better efficiency and better innovation than a reduced supply base. This means that in the first stages of supplier integration or in absence of such activity, companies should rely on a large pool of suppliers to benefit from the related advantages, but, as integration increases, the number of suppliers must be reduced to fully exploit collaboration's benefits. Therefore, the idea that a smaller supply base improves innovation and reduces costs is true, but only as long as the company develops a medium-advanced collaboration with its suppliers.

Finally, the research findings support the importance of using a fine-grained approach to investigate the effects of supplier integration on performance. Indeed, with our analysis, we do not only show that each dimension of supplier integration has a different effect on efficiency and innovation, but also that they interact with supply base reduction in different ways. This is may also be one of the reasons why previous research is characterized by contrasting findings related to the SI-performance link: by incorporating all the activities into a single construct, the specific characteristics and effects of the individual dimensions can be lost.

6.6 Conclusions

This research investigates the interaction between SI and supply base reduction and the impact on efficiency and innovation. The findings show that there must be a consistency between supplier integration and supply base rationalization decisions. These two supply chain management practices operate with a synergic effect on efficiency and innovation and, for this reason, must be essential parts of a concerted strategy.

Despite the theoretical and managerial contributions highlighted in the previous section, this study has some limitations that must be pointed out.

First, this study considers a limited set of operational performance measures. Companies may implement SI initiatives not only to improve efficiency and innovation, but also to be more responsive to customers' requirements or to improve customer service. Future research should thus consider additional performance indicators, including both operational and financial measures.

Other limitations concern instead the strategic dimensions of supplier integration included in the research. As regards supplier involvement in NPD, we considered only the so-called supplier process integration, a practice in which customers involve suppliers into their internal NPD processes, while we neglected another possible form of integration in NPD, the supplier product integration, in which suppliers directly assume the responsibility to develop parts or subassemblies (see Koufteros et al., 2005). Future research could address also this latter dimension, investigating if it interacts with supply base reduction. Similarly, supplier development could be further distinguished into different initiatives and it would be interesting to assess if their separated effect on performance is moderated by supply base reduction. It may be useful for managers to understand if some supplier development practices are beneficial also without a reduction of the supply base.

This research focused on the moderating role of supply base reduction, but several other variables may act with a contingent effect on SI, deserving attention in future research. In particular, it would be interesting to create a construct of supply base complexity conceptualized as Choi and Krause (2006) do in their qualitative study, namely including information on number of suppliers, degree of differentiation and level of interrelationships among suppliers. The collection of such data would be more difficult and require the involvement of suppliers' managers, besides the focal company's ones, but the research would be useful to understand how to properly design the supplier network to maximize SI investments.

Finally, the research setting, which focuses on electronics, machinery and transportation sectors, could limit the generalizability of the results. Future research should thus extend the analysis including companies belonging to other industries.

Chapter 7
GENERAL CONCLUSIONS

This thesis examined the huge topic of Supply Chain Integration, considering not only the role of context in shaping its debated relationship with firm performance, but also some effective ways to implement and improve it.

In particular, the three research objectives addressed in the PhD research were:

1. To investigate the role of context in shaping the relationship between supply chain integration and performance;
2. To understand how to properly implement supply chain integration;
3. To identify and empirically investigate contingent factors that interact with supply chain integration to provide the maximum performance benefits to companies.

Three different scientific papers, that are collected and integrated in the present work, addressed each of these goals and used a specific and different methodology (i.e. Systematic Literature Review, multiple case study, survey).

Since the three papers are fully integrated in this thesis and each one includes a description of its own results, implications and limitations, this concluding section aims at providing an overview of the PhD project contributions and limitations, which derive partially from the single papers and partially from additional and general considerations of the entire work.

Overall, it is possible to identify at least five key contributions of the PhD research, which are related to both academy and practice. Each paper participates to the provision of the five contributions in a different way.

From a theoretical point of view, the contributions are three.

First of all, this thesis provides a detailed and original overview of the SCI literature, which reflects a deep understanding of the state-of-the-art of the related research. The main contribution in this sense is given by the Systematic Literature Review of the first paper, whose novelty compared to previous literature reviews is twofold. Indeed, it is not only the first review that directly focuses on the role of context in influencing the effect of SCI on performance, but it also classifies previous literature with an original perspective, Venkatraman's (1980) fit. This allows to investigate, describe and compare the results for each fit type, but also to consider possible combinations of different fit forms. Scholars interested in understanding the fit between context, SCI and performance can find in this paper an orderly and structured review of the literature that shows: the forms of integration considered in the analyses (in terms of direction, type and processes involved), the theories used to support the studies, the methodologies used to test the hypotheses, the contextual variables and macro-categories investigated by researchers and the related results.

Second, this thesis complements the results found in previous studies and extends our knowledge on the topic of SCI. Two research streams are mainly affected by the present work:

- The academic research dealing with the implementation and development of an S&OP process.

  Through the second paper, this thesis provides knowledge on the dynamics of evolution from one S&OP maturity stage to another, analyzing how the process dimensions interact with each other during the transition. In particular, it shows that there is not a unique and best temporal sequence to implement the process, since the idea that changes in the organizational structure should be followed in order by improvements in processes and methodologies, in information technologies and in performance measurement systems is only partially true. Indeed, while in the transition between lowest maturity stages the dimensions can be addressed in an almost pure serial way, when the maturity increases the dimensions become interdependent and need to be addressed in parallel, making the advanced transitions more difficult to realize.

- The academic research dealing with the relationship between supplier integration and performance.

  Through the third paper, this thesis complements existing studies on complementarities by identifying an additional contingent factor that interacts with supplier integration to improve performance: supply base reduction. The literature is not clear in suggesting if companies should combine supplier integration practices with initiatives aimed at reducing the supply base and evidence based on a large sample that supply base reduction positively moderates the relationship between supplier integration and efficiency and innovation is novel in the literature.

  In addition, using a fine-grained approach to investigate supplier integration, the thesis shows that the different dimensions of supplier integration do not weight the same importance when it comes to efficiency and innovation, because each of them has a different main effect on performance and a different complementary effect with supply base size. This fine-grained analysis is again novel in the supplier integration literature.

Third, this thesis identifies future research directions that can be used by scholars to provide additional contributions to the SCI literature. Obviously, the first paper is the main provider of such suggestions, not only by identifying additional antecedents or moderators of the SCI-performance link that could be tested in future studies, but also by recommending the application of different fit types to address unresolved issues on SCI. The second and third paper provide future research directions that, despite being more specific to the topics addressed in their studies, are still relevant for the SCI literature. For instance, as regards S&OP, it would be interesting to integrate maturity models and performance concepts, providing evidence of the benefits that can be achieved moving from one stage to the following one. As concerns instead supplier integration, a promising line of future research is related to the effect of IT-based supplier integration. Scholars have not yet found an agreement on the effective benefits of IT integration and the particular results of the third paper make the debate anything but closed.

From a managerial point of view, the contributions can be grouped into two main streams.
First, this thesis provides indications to managers on how to implement SCI and, in particular, on what elements and aspects should be taken into consideration to properly develop SCI practices. As regards S&OP, the second paper not only provides guidelines on how to develop the process according to the starting level of maturity, but it also advises managers that an effective implementation of S&OP requires appropriate actions in all the dimensions, namely organization, processes, tools and performance indicators. As regards instead supplier integration, managers should be aware that, in order to maximize performance, they must implement strategic and operational supplier integration initiatives together with actions aimed at reducing their supply base.
Second, this thesis identifies potential mistakes and drawbacks that could easily hinder the effective implementation of SCI or the achievement of its expected benefits. These mistakes can be summarized as follows:

- Assume that SCI is always beneficial, without considering the influence of context or the fact that SCI may interact with each other.
- Underestimate the key role of people and the importance of the organizational structure for SCI success.

  Paper two claims that managers would make a mistake by underestimating the criticality of the people and organization dimension of S&OP, which is not only the first element to be addressed in the S&OP development, but also the most critical and time-consuming one. On the same vein, the third paper identifies the lack of a proper organization structure as one of the probable causes of the negative effects exerted by technology-based supplier integration on efficiency. Finally, as signaled by the first paper, people's knowledge, skills and characteristics act as antecedents of different forms of SCI, confirming the key role of people in driving both processes and performance.
- Rely on a large supply base when supplier integration is at high level or on a small one when it is not implemented.

  As it emerged from the third paper, there must be a consistency between supplier integration and supply base rationalization because they operate with a synergic effect on performance and, for this reason, must be essential parts of a concerted strategy.

The results and contributions of this thesis should however be viewed in light of some limitations. As already underlined, each paper has its own specific limitations. However, it is possible to make a critical analysis of the PhD project, comparing the results found with the three PhD goals.

The first goal was reached through the systematic literature review, but, as underlined in this paper, the selection criteria limit the final sample of the analysis and, in particular, exclude all qualitative and conceptual papers that could however enhance our knowledge on the topic. Future studies should thus extend the investigation also to such studies to verify if the findings of the quantitative-related review are confirmed and if additional results can be identified.

As concerns the second goal, it was addressed only in the context of Sales and Operations Planning. It would be interesting to understand how to implement also other forms of SCI, extending the use of maturity models and possibly identifying specific contexts of application. For instance, these context-specific maturity models could substitute the S&OP dimensions with different forms of SCI and consequently indicate which direction of integration (i.e. upstream or downstream) or which type of integration (e.g. operational or IT-based) should be developed first, providing indications on the best implementation sequences in terms of mix of SCI practices varying over the time.

The third goal was probably the most ambitious one. The third paper identifies supply base reduction as a contingent factor that interacts with supplier integration to influence efficiency and innovation, but many other moderators could be found. A possible idea for future research would be to consider the characteristics of both upstream and downstream network, investigating if they interact with supplier and customer integration and comparing the two sides of the network.

Overall, a final general consideration deriving from this PhD research is that SCI, despite being an old topic, is a huge research area where many theoretical and managerial contributions could and should still be done. Concluding that it is a mature topic is an oversimplification and would neglect, besides others, all the opportunities recognized in the present work.

REFERENCES

Acemoglu, D., Dorn, D., Hanson, G. H., and Price, B., 2014. Return of the Solow paradox? IT, productivity, and employment in US manufacturing. *American Economic Review* 104(5), 394-99.

Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D., and Overy, P., 2015. Sustainability-oriented Innovation: A Systematic Review. *International Journal of Management Reviews* 18, 180-205.

Adams, F. G., Richey Jr, R. G., Autry, C.W., Morgan, T. R., and Gabler, C.B., 2014. Supply chain collaboration, integration, and relational technology: How complex operant resources increase performance outcomes. *Journal of Business Logistics* 35(4), 299-317.

Alfalla-Luque, R., Medina-Lopez, C., and Dey, P. K., 2013. Supply chain integration framework using literature review. *Production Planning and Control* 24(8-9), 800-817.

Alfalla-Luque, R., Machuca, J. A., and Marin-Garcia, J. A., 2018. Triple-A and competitive advantage in supply chains: Empirical research in developed countries. *International Journal of Production Economics* 203, 48-61.

Alfalla-Luque, R., Marin-Garcia, J. A., and Medina-Lopez, C., 2015. An analysis of the direct and mediated effects of employee commitment and supply chain integration on organisational performance. *International Journal of Production Economics* 162, 242-257.

Ambrose, S. C., Matthews, L. M., and Rutherford, B. N., 2018. Cross-functional teams and social identity theory: A study of sales and operations planning (S&OP). *Journal of Business Research* 92, 270-278.

APICS Dictionary, 14th Edition. 2013. John H. Blackstone editor. University of Georgia. USA.

Ataseven, C., and Nair, A., 2017. Assessment of supply chain integration and performance relationships: A meta-analytic investigation of the literature. *International Journal of Production Economics* 185, 252-265.

Ateş, M. A., Wynstra, F., and van Raaij, E. M., 2015. An exploratory analysis of the relationship between purchase category strategies and supply base structure. *Journal of Purchasing and Supply Management 21*(3), 204-219.

Bagozzi, R.P., Yi, Y., and Phillips, L.W., 1991. Assessing construct validity in organizational research. *Administrative Science Quarterly* 36(3), 421–458.

Baihaqi, I., and Sohal, A.S., 2013. The impact of information sharing in supply chains on organisational performance: an empirical study. *Production Planning and Control* 24(8-9), 743-758.

Barney, J., 1991. Firm resources and sustained competitive advantage. *Journal of Management* 17, 99–120.

Baron, R. M., and Kenny, D. A., 1986. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology* 51, 1173-1182.

Barrett, J., and Uskert., M., 2010. Sales and Operations Planning Maturity: What Does It Take to Get and Stay There? Gartner RAS Core Research Note G00207249, November 1.

Beugelsdijk, S., Ambos, B., and Nell, P. C., 2018. Conceptualizing and measuring distance in international business research: Recurring questions and best practice guidelines. *Journal of International Business Studies* 49, 1113–1137.

Bhattacharya, S., Gupta, A., and Hasija, S., 2018. Single-Sourcing Versus Multisourcing: The Roles of Output Verifiability on Task Modularity. *MIS Quarterly* 42(4), 1171-1186.

Blarr, W. H., 2012. Organizational Ambidexterity. Implications for the Strategy-Performance Linkage. Leipzig, Germany, Springer Gabler.

Blome, C., Paulraj, A., and Schuetz, K., 2014. Supply chain collaboration and sustainability: a profile deviation analysis. *International Journal of Operations and Production Management* 34(5), 639-663.

Boyer, K. K., and Verma, R., 2000. Multiple raters in survey-based operations management research: a review and tutorial. *Production and Operations Management* 9(2), 128–140.

Boon-itt, S., and Wong, C. Y., 2011. The moderating effects of technological and demand uncertainties on the relationship between supply chain integration and customer delivery performance. *International Journal of Physical Distribution and Logistics Management* 41(3), 253-276.

Bortolotti, T., and Romano, P., 2012. Lean first, then automate: a framework for process improvement in pure service companies. A case study. *Production Planning & Control* 23(7): 513–522.

Boscari, S., Danese, P., and Romano, P., 2016. Implementation of lean production in multinational corporations: A case study of the transfer process from headquarters to subsidiaries. *International Journal of Production Economics* 176: 53-68.

Brambor, T., Clark, W. R. and Golder, M., 2006. Understanding interaction models: improving empirical analyses. *Political Analysis* 14, 63-82.

Braunscheidel, M. J., Suresh, N. C., and Boisnier, A. D., 2010. Investigating the impact of organizational culture on supply chain integration. *Human Resource Management* 49(5), 883-911.

Bruque-Cámara, S., Moyano-Fuentes, J., and Maqueira-Marín, J. M., 2016. Supply chain integration through community cloud: Effects on operational performance. *Journal of Purchasing and Supply Management* 22(2), 141-153.

Brynjolfsson, E., 1993. The productivity paradox of information technology: Review and assessment. *Communications of the ACM*, 36(12).

Burke, G. J., Carrillo, J. E., and Vakharia, A. J., 2007. Single versus multiple supplier sourcing strategies. *European Journal of Operational Research*, 182(1), 95-112.

Cai, S., Jun, M., and Yang, Z., 2009. Implementing supply chain information integration in China: The role of institutional forces and trust. *Journal of Operations Management* 28(3), 257-268.

Caniato, F., and Größler, A., 2015. The moderating effect of product complexity on new product development and supply chain management integration. *Production Planning and Control* 26(16), 1306-1317.

Cao, M., Vonderembse, M. A., Zhang, Q., and Ragu-Nathan, T.S., 2010. Supply chain collaboration: conceptualisation and instrument development. International Journal of Production Research48(22), 6613-6635.

Cao, M., and Zhang, Q., 2011. Supply chain collaboration: Impact on collaborative advantage and firm performance. Journal of Operations Management 29(3), 163-180.

Carr, A. S., and Kaynak H., 2007. Communication methods, information sharing, supplier development and performance: An empirical study of their relationships. International Journal of Operations and Production Management 27(4), 346-370.

Cecere, L., Barret, J., and Mooraj, H., 2009. Sales and Operations Planning: Transformation From Tradition. Industry Value Chain Strategies. Boston, MA: AMR Research.

Chang, W., Ellinger, A. E., Kim, K. K., and Franke, G. R., 2016. Supply chain integration and firm financial performance: A meta-analysis of positional advantage mediation and moderating factors. *European Management Journal* 34(3), 282-295.

Chavez, R., Yu, W., Gimenez, C., Fynes, B., and Wiengarten, F., 2015. Customer integration and operational performance: The mediating role of information quality. *Decisions Support Systems* 80, 83-95.

Chaudhuri, A., Boer, H., and Taran, Y., 2018. Supply chain integration, risk management and manufacturing flexibility. *International Journal of Operations and Production Management* 38(3), 690-712.

Chen, H., Daugherty, P. J., and Landry, T. D., 2009. Supply chain process integration: a theoretical framework. *Journal of Business Logistics* 30(2), 27-46.

Chen, I. J., and Paulraj, A., 2004. Towards a theory of supply chain management: the constructs and measurements. *Journal of Operations Management 22*(2), 119-150.

Chen, M. C., Yang, T., and Li, H. C., 2007. Evaluating the supply chain performance of IT-based inter-enterprise collaboration. *Information & Management* 44(6), 524-534.

Chen, L., Zhao, X., Tang, O., Price, L., Zhang, S., and Zhu, W., 2017. Supply chain collaboration for sustainability: A literature review and future research agenda. *International Journal of Production Economics* 194, 73-87.

Choi, T. Y., and Hong, Y., 2002. Unveiling the structure of supply networks: case studies in Honda, Acura, and DaimlerChrysler. *Journal of Operations Management* 20(5): 469-493.

Choi, T. Y., and Krause, D. R., 2006. The supply base and its complexity: Implications for transaction costs, risks, responsiveness, and innovation. *Journal of Operations Management* 24(5), 637-652.

Coase, R. H. (1937). The nature of the firm. Economica, 4 (16), 386–405.

Cohen, J. and Cohen, P., 1983. Applied Multiple Regression for the Behavioral Sciences, Lawrence Erlbaum, Hillsdale, NJ.

Cooper, M. C., Lambert, D. M., and Pagh, J. D., 1997. Supply Chain Management: More Than a New Name for Logistics. *The International Journal of Logistics Management* 8(1): 1-14.

Croson, R., Schultz, K., Siemsen, E., and Yeo, M. L., 2013. Behavioral operations: the state of the field. *Journal of Operations Management* 31(1-2), 1-5.

da Silveira, G. J., and Cagliano, R., 2006. The relationship between interorganizational information systems and operations performance. *International Journal of Operations & Production Management* 26(3), 232-253.

Dai, J., Cantor, D. E., and Montabon, F. L., 2017. Examining corporate environmental proactivity and operational performance: A strategy-structure-capabilities-performance perspective within a green context. *International Journal of Production Economics* 193, 272-280.

Danese, P., 2006. Collaboration forms, information and communication technologies, and coordination mechanisms in CPFR. *International Journal of Production Research* 44(16): 3207–3226.

Danese, P., 2011. Towards a contingency theory of collaborative planning initiatives in supply networks. *International Journal of Production Research* 49(4): 1081-1103.

Danese, P., 2013. Supplier integration and company performance: A configurational view. *Omega* 41(6), 1029-1041.

Danese, P., and Bortolotti, T., 2014. Supply chain integration patterns and operational performance: a plant-level survey-based analysis. *International Journal of Production Research* 52(23), 7062-7083.

Danese, P., Molinaro, M., and Romano, P., 2018. Managing evolutionary paths in Sales and Operations Planning: key dimensions and sequences of implementation. *International Journal of Production Research* 56(5), 2036-2053.

Danese, P., and Romano, P., 2011a. Supply chain integration and efficiency performance: a study on the interactions between customer and supplier integration. *Supply Chain Management: an International Journal* 16(4), 220–230.

Danese, P., and Romano, P., 2011b. Relationship between downstream integration, performance measurement systems and supply network efficiency. *International Journal of Production Research* 50(7), 2002-2013.

Danese, P., and Romano, P., 2013. The moderating role of supply network structure on the customer integration-efficiency relationship. *International Journal of Operations and Production Management* 33(4), 372-393.

Danese, P., Romano, P., and Formentini, M., 2013. The impact of supply chain integration on responsiveness: The moderating effect of using an international supplier network. *Transportation Research Part E* 49(1), 125-140.

Das, A., Narasimhan, R., and Talluri, S., 2006. Supplier integration—Finding an optimal configuration. *Journal of Operations Management* 24(5), 563–582.

David, R. J., and Han, S. K., 2004. A systematic assessment of the empirical support for transaction cost economics. *Strategic Management Journal* 25(1), 39-58.

de Bruin, T., Rosemann, M., Freeze, R., and Kulkarni, U., 2005. Understanding the Main Phases of Developing a Maturity Assessment Model. *Proceedings of the 16th Australasian Conference on Information Systems*, Sydney, Australia, November 29–December 2.

Delic, M., Eyers, D. R., and Mikulic, J., 2019. Additive manufacturing: empirical evidence for supply chain integration and performance from the automotive industry. *Supply Chain Management: An International Journal* 24(5), 604-621.

Devaraj, S., Krajewski, L., and Wei, J. C., 2007. Impact of eBusiness technologies on operational performance: The role of production information integration in the supply chain. *Journal of Operations Management* 25(6), 1199-1216.

Dong, Y., Carter, C. R., and Dresner, M. E., 2001. JIT purchasing and performance: an exploratory analysis of buyer and supplier perspectives. *Journal of Operations Management* 19(4), 471-483.

Dornier, P. P., Ernst, R., Fender, M., and Kouvelis, P., 1998. Global Operations and Logistics: Text and cases. John Wiley and Sons, New York.

Drazin, R., and Van de Ven, A. H., 1985. Alternative forms of fit in contingency theory. *Administrative Science Quarterly* 30 (4), 514–539.

Droge, C., Jayaram, J., and Vickery, S. K., 2004. The effects of internal versus external integration practices on time-based performance and overall firm performance. *Journal of Operations Management* 22(6), 557-573.

Droge, C., Vickery, S. K., and Jacobs, M. A., 2012. Does supply chain integration mediate the relationships between product/process strategy and service performance? An empirical study. *International Journal of Production Economics* 137(2), 250-262.

Dyer, J. H., and Singh, H., 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review* 23 (4), 660–679

Ebrahimi, S.M., Koh, S. C. L., Genovese, A., and Kumar, N., 2018. Structure-integration relationships in oil and gas supply chains. International *Journal of Operations and Production Management* 38(2), 424-445.

Edwards, J. R., and Lambert, L. S., 2007. Methods for Integrating Moderation and Mediation: A General Analytical Framework Using Moderated Path Analysis. *Psychological Methods* 12(1), 1-22.

Eisenhardt, K., 1989. Building theories from case study research. *Academy of Management Review* 14 (4): 532–550.

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

Ensign, P. C., 2001. The concept of fit in organizational research. *International Journal Organization Theory and Behavior* 4(3-4), 287-306.

Fabbe-Costes, N. and Jahre, M., 2007. Supply chain integration improves performance: the Emperor's new suit? *International Journal of Physical Distribution and Logistics Management* 37(10), 835-855.

Fabbe-Costes, N., and Jahre, M., 2008. Supply chain integration and performance: a review of the evidence. *The International Journal of Logistics Management* 19(2), 130-154.

Feng, Y., D'Amours, S., and Beauregard, R., 2008. The value of sales and operations planning in oriented strand board industry with make-to-order manufacturing system: Cross functional integration under deterministic demand and spot market recourse. *International Journal of Production Economics* 115(1): 189–209.

Feng, Y., D'Amours, S., and Beauregard, R., 2010. Simulation and performance evaluation of partially and fully integrated sales and operations planning. *International Journal of Production Research* 48(19): 5859-5883.

Flynn, B. B., Huo, B., and Zhao, X., 2010. The impact of supply chain integration on performance: A contingency and configuration approach. *Journal of Operations Management* 28(1), 58-71.

Fornell, C., and Larcker, D. F., 1981. Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research* 18 (1), 39–50.

Frohlich, M. T., and Westbrook, R., 2001. Arcs of integration: an international study of supply chain strategies. *Journal of Operations Management* 19(2), 185–200.

Fynes, B., de Búrca, S., and Marshall, D., 2004. Environmental uncertainty, supply chain relationship quality and performance. *Journal of Purchasing and Supply Management* 10(4-5), 179-190.

Gable, G. G., Sedera, D., and Chan, T., 2008. Re-conceptualizing Information System Success: The IS-Impact Measurement Model. *Journal of the Association for Information Systems* 9(7): 377-408.

Garrido-Vega, P., Jimenez, C. H. O., and Morita, M., 2015. Implementation of technology and production strategy practices: Relationship levels in different industries. *International Journal of Production Economics* 161, 201-216.

Germain, R., Claycomb, C., and Droge, C., 2008. Supply chain variability, organizational structure, and performance: The moderating effect of demand unpredictability. *Journal of Operations Management* 26(5), 557-570.

Giannakis, M., 2008. Facilitating learning and knowledge transfer through supplier development. *Supply Chain Management: An International Journal 13*(1), 62-72.

Gimenez, C., van der Vaart, T., and van Donk, D. P., 2012. Supply chain integration and performance: the moderating effect of supply complexity. *International Journal of Operations and Production Management* 32(5), 583-610.

Goh, S. H., and Eldridge, S., 2015. New product introduction and supplier integration in sales and operations planning. Evidence from the Asia Pacific region. *International Journal of Physical Distribution & Logistics Management* 45(9/10): 861–886.

Goh, S. H., and Eldridge, S., 2019. Sales and Operations Planning: The effect of coordination mechanisms on supply chain performance. *International Journal of Production Economics* 214, 80-94.

Golini, R., and Kalchschmidt, M., 2015. Managing inventories in global sourcing contexts: A contingency perspective. *International Journal of Production Economics 165*, 64-78.

Grant, R. M., 1996. Toward a knowledge-based theory of the firm. *Strategic Management Journal* 17, 109–122.

Grimson, J. A., and Pyke, D. F., 2007. Sales and Operations Planning: An Exploratory Study and Framework. *International Journal of Logistics Management* 18(3): 322–346.

Gualandris, J., Golini, R., and Kalchschmidt, M., 2014. Do supply management and global sourcing matter for firm sustainability performance? An international study. *Supply Chain Management: An International Journal* 19(3), 258-274.

Hair, J. F. Jr., Black, W. C., Babin, B. J., Anderson, R. E. and Tatham, R. L., 2006. Multivariate Data Analysis, Prentice-Hall, Englewood Cliffs, NJ.

Handfield, R.B, Krause, D. R., Scannell, T. V., and Monczka, R. M., 2000. Avoid the Pitfalls in Supplier Development. *MIT Sloan Management Review* 41(2): 37-49.

Hayes, A. F., 2013. Introduction to mediation, moderation, and conditional process analysis. New York, NY: Guildford Press.

Heese, H. S., 2015. Single versus multiple sourcing and the evolution of bargaining positions. *Omega*, 54, 125-133.

Hulthén, H., Näslund, D., and Norrman, A., 2016. Framework for measuring performance of the sales and operations planning process. *International Journal of Physical Distribution & Logistics Management* 46(9): 809-835.

Huo, B., 2012. The impact of supply chain integration on company performance: an organizational capability perspective. *Supply Chain Management: an International Journal* 17(6), 596-610.

Huo, B., Ye, Y., Zhao, X., and Shou, Y., 2016. The impact of human capital on supply chain integration and competitive performance. *International Journal of Production Economics* 178, 132-143.

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

Ivert, K. L., Dukovska-Popovska, I., Kaipia, R., Fredriksson, A., Dreyer, H. C., Johansson, M. I., Chabada, L., Damgaard, C. M., and Tuomikangas, N., 2015b. Sales and operations planning: responding to the needs of industrial food producers. *Production Planning & Control* 26(4): 280-295.

Jaccard, J., and Turrisi, R., 2003. Interaction Effect in Multiple Regression, second ed. Sage, Thousand Oaks.

Jacobs, M., Vickery, S. K., and Droge, C., 2007. The effects of product modularity on competitive performance: Do integration strategies mediate the relationship? *International Journal of Operations and Production Management* 27(10), 1046-1068.

Jacobs, M. A., Yu, W., and Chavez, R., 2016. The effect of internal communication and employee satisfaction on supply chain integration. *International Journal of Production Economics* 171(1), 60-70.

Jajja, M. S. S., Chatha, K. A., and Farooq, S., 2018. Impact of supply chain risk on agility performance: Mediating role of supply chain integration. *International Journal of Production Economics* 205, 118-138.

Jonsson, P., and Holmström, J., 2016. Future of supply chain planning: closing the gaps between practice and promise. *International Journal of Physical Distribution & Logistics Management* 46(1): 62-81.

Kamal, M. M., and Irani, Z., 2014. Analysing supply chain integration through a systematic literature review: a normative perspective. *Supply Chain Management: an International Journal* 19(5/6), 523-557.

Kannan, V. R., Tan, K. C., 2010. Supply chain integration: cluster analysis of the impact of span of integration. *Supply Chain Management: an International Journal* 15(3), 207-215.

Kauppi, K., Longoni, A., Caniato, F., and Kuula, M., 2016. Managing country disruption risks and improving operational performance: risk management along integrated supply chains. *International Journal of Production Economics* 182, 484-495.

Khan, M., Hussain, M., and Saber, H. M., 2016. Information sharing in a sustainable supply chain. *International Journal of Production Economics* 181, 208-214.

Kim, D. Y., 2013. Relationship between supply chain integration and performance. *Operations Management Research* 6(1-2), 74-90.

Kim, G., Lin, W. T., and Simpson, N. C., 2015. Evaluating the performance of US manufacturing and service operations in the presence of IT: a Bayesian stochastic production frontier approach. *International Journal of Production Research* 53(18), 5500-5523.

Kim, J. U., and Aguilera, R. V., 2016. Foreign location choice: review and extensions. *International Journal of Management Reviews* 18, 133-159.

Kim, S. W., 2006. Effects of supply chain management practices, integration and competition capability on performance. *Supply Chain Management: an International Journal* 11(3), 241-248.

Kim, S. W., 2009. An investigation on the direct and indirect effect of supply chain integration on firm performance. *International Journal of Production Economics* 119(2), 328-346.

Kim, Y. H., and Schoenherr, T., 2018. The Effects of Supply Chain Integration on the Cost Efficiency of Contract Manufacturing. *Journal of Supply Chain Management* 54(3), 42-64.

Koufteros, X. A., Cheng, T. E., and Lai, K. H., 2007. "Black-box" and "gray-box" supplier integration in product development: Antecedents, consequences and the moderating role of firm size. *Journal of Operations Management 25*(4), 847-870.

Koufteros, X. A., Rawski, G. E., and Rupak, R., 2010. Organizational Integration for Product Development: The Effects on Glitches, On-Time Execution of Engineering Change Orders, and Market Success. *Decision Sciences* 41(1), 49-80.

Koufteros, X., Vickery, S. W., and Droge, C., 2012. The effects of strategic supplier selection on buyer competitive performance in matched domains: does supplier integration mediate the relationships? *Journal of Supply Chain Management* 48(2), 93-115.

Koufteros, X., Vonderembse, M., and Jayaram, J., 2005. Internal and External Integration for Product Development: The Contingency Effects of Uncertainty, Equivocality, and Platform Strategy. *Decision Sciences* 36(1), 97-133.

Krause, D. R., and Ellram, L. M., 1997. Success factors in supplier development. *International Journal of Physical Distribution & Logistics Management 27*(1), 39-52.

Krause, D. R., Handfield, R. B., and Scannell, T. V., 1998. An empirical investigation of supplier development: reactive and strategic processes. *Journal of Operations Management*, *17*(1), 39-58.

Krause, D. R., Handfield, R. B., and Tyler, B. B., 2007. The relationships between supplier development, commitment, social capital accumulation and performance improvement. *Journal of Operations Management* 25(2), 528-545.

Krippendorff, K., 1970. Bivariate agreement coefficients for reliability of data. *Sociological methodology* 2, 139-150.

Kristensen, J., and Jonsson, P., 2018. Context-based sales and operations planning (S&OP) research: a literature review and future agenda. I*nternational Journal of Physical Distribution & Logistics Management* 48(1), 19-46.

Kumar, G., Subramanian, N., and Ramkumar, M., 2018. Missing link between sustainability collaborative strategy and supply chain performance: Role of dynamic capability. *International Journal of Production Economics* 203, 96-109.

Lapide, L., 2005. Sales & Operations Planning Part III: A Diagnostic Model. *Journal of Business Forecasting* 24(1): 13–16.

Lau, C., Tse, D. K., and Zhou, N., 2002. Institutional Forces and Organizational Culture in China: Effects on Change Schemas, Firm Commitment and Job Satisfaction. *Journal of International Business Studies* 33(3), 533-550.

Lawrence, P., and Lorsch, J., 1967. Organization and Environment: Managing Differentiation and Integration. Irwin, Illinois.

Leuschner, R., Rogers, D. S., and Charvet, F. F., 2013. A meta-analysis of supply chain integration and firm performance. *Journal of Supply Chain Management* 49(2), 34-57.

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

Li, S., and Lin, B., 2006. Accessing information sharing and information quality in supply chain management. *Decision support systems* 42(3), 1641-1656.

Li, W., Humphreys, P. K., Yeung, A. C., and Cheng, T. E., 2007. The impact of specific supplier development efforts on buyer competitive advantage: an empirical model. *International Journal of Production Economics* 106(1), 230-247.

Li, W., Humphreys, P. K., Yeung, A. C., and Cheng, T. C. E., 2012. The impact of supplier development on buyer competitive advantage: A path analytic model. *International Journal of Production Economics* 135(1), 353-366.

Liao, S. H., Hu, D. C., and Ding, L. W., 2017. Assessing the influence of supply chain collaboration value innovation, supply chain capability and competitive advantage in Taiwan's networking communication industry. *International Journal of Production Economics* 191, 143-153.

Lii, P., and Kuo, F., 2016. Innovation-oriented supply chain integration for combined competitiveness and firm performance. *International Journal of Production Economics* 174, 142-155.

Ling, D., and A. Coldrick., 2009. Breakthrough Sales & Operations Planning: How we developed the process. Accessed 14 December 2015. http://dickling.net/wp-content/uploads/2016/07/breakthrough.pdf

Liu, G. J., Shah, R., and Schroeder, R.G., 2012. The relationships among functional integration, mass customisation, and firm performance. *International Journal of Production Research* 50(3), 677-690.

Liu, H., Ke, W., Wei, K. K., and Hua, Z., 2013. Effects of supply chain integration and market orientation on firm performance: Evidence from China. *International Journal of Operations and Production Management* 33(3), 322-346.

Lo, S. M., Zhang, S., Wang, Z., and Zhao, X., 2018. The impact of relationship quality and supplier development on green supply chain integration: A mediation and moderation analysis. *Journal of Cleaner Production* 202, 524-535.

Lu, G., and Shang, G., 2017. Impact of supply base structural complexity on financial performance: Roles of visible and not-so-visible characteristics. *Journal of Operations Management 53*, 23-44.

Mackelprang, A. W., Robinson, J. L., Bernardes, E., and Webb, G. S., 2014. The relationship between strategic supply chain integration and performance: a meta-analytic evaluation and implications for supply chain management research. *Journal of Business Logistics* 35(1), 71-96.

Mckone-Swee, K., and Lee, Y., 2009. Development and analysis of a supply chain strategy taxonomy. *Journal of Supply Chain Management* 45(3), 3-24.

Michalski, M., Montes-Botella, J. L., and Narasimhan, R., 2018. The impact of asymmetry on performance in different collaboration and integration environments in supply chain management. *Supply Chain Management: an International Journal* 23(1), 33-49.

Mihalache, M., and Mihalache, O. R., 2015. A Decisional Framework of Offshoring: Integrating Insights from 25 Years of Research to Provide Direction for Future. *Decision Sciences* 47, 1103-1149.

Milgrom P., and Roberts J., 1995. Complementarities and fit – strategy, structure, and organizational change in manufacturing. *Journal of Accounting and Economics* 19(2/3):179–208.

Mishra, A. A., and Shah, R., 2009. In union lies strength: Collaborative competence in new product development and its performance effects. *Journal of Operations Management* 27(4), 324-338.

Moyano-Fuentes, J., Sacristán-Díaz, M., and Garrido-Vega, P., 2016. Improving supply chain responsiveness through Advanced Manufacturing Technology: the mediating role of internal and external integration. *Production Planning and Control* 27(9), 686-697.

Narasimhan, R., Talluri, S., and Mendez, D., 2001. Supplier evaluation and rationalization via data envelopment analysis: an empirical examination. *Journal of Supply Chain Management 37*(2), 28-37.

Negahban, A., and Smith, J. S., 2016. The effect of supply and demand uncertainties on the optimal production and sales plans for new products. *International Journal of Production Research* 54(13): 3852-3869.

Nolan, R. L., 1979. Managing the crises in data processing. *Harvard Business Review* March-April: 115-126.

Nolan, C. T., and Garavan, T. N., 2016. Human Resource Development in SMEs: A Systematic Review of the Literature. *International Journal of Management Reviews* 18, 85-107.

Nunnally, J. C., and Bernstein, I. H., 1994. Psychometric theory (3rd ed.). New York, NY: McGraw-Hill.

Ogden, J. A., and Carter, P. L., 2008. The supply base reduction process: an empirical investigation. *The International Journal of Logistics Management 19*(1), 5-28.

Olhager, J., 2013. Evolution of operations planning and control: from production to supply chains. *International Journal of Production Research* 51(23-24): 6836-6843.

Oliva, R., and Watson, N., 2011. Cross-functional alignment in supply chain planning: A case study of sales and operations planning. *Journal of Operations Management* 29(5): 434-448.

Pandey, P., Bhattacharyya, S., and Kaur, A. 2012. Exploring the role of HR practices in supply chain. *Journal of Advances in Management Research* 9(1), 113-123.

Parker, H., 2012. Knowledge acquisition and leakage in inter-firm relationships involving new technology-based firms. *Management Decision 50*(9), 1618-1633.

Parker, H., and Brey, Z., 2015. Collaboration costs and new product development performance. *Journal of Business Research 68*(7), 1653-1656.

Parthasarthy, R., and Hammond, J., 2002. Product Innovation input and outcome: moderating effect on the innovation process. *Journal of Engineering and Technology Management*, 19(1), 75–91.

Paulraj, A., and Chen, I. J., 2005. Strategic supply management and dyadic quality performance: a path analytical model. *Journal of Supply Chain Management 41*(3), 4-18.

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

Peng, D. X., Heim, G. R., and Mallick, D. N., 2014. Collaborative product development: The effect of project complexity on the use of information technology tools and new product development practices. *Production and Operations Management* 23(8), 1421-1438.

Peng, D. X., Verghese, A., Shah, R., and Schroeder, R. G., 2013. The relationships between external integration and plant improvement and innovation capabilities: the moderation effect of product clockspeed. *Journal of Supply Chain Management 49*(3), 3-24.

Perols, J., Zimmermann, C., and Kortmann, S., 2013. On the relationship between supplier integration and time-to-market. *Journal of Operations Management 31*(3), 153-167.

Petersen, K. J., Handfield, R. B., and Ragatz, G. L., 2003. A model of supplier integration into new product development. *Journal of Product Innovation Management 20*(4), 284-299.

Petersen, K. J., Handfield, R. B., and Ragatz, G. L., 2005. Supplier integration into new product development: coordinating product, process and supply chain design. *Journal of Operations Management 23*(3-4), 371-388.

Poeppelbuss, J., Niehaves, B., Simons, A., and Becker, J., 2011. Maturity Models in Information Systems Research: Literature Search and Analysis. *Communication of the Association for Information Systems* 29(1): 505-532.

Polák, P., 2017. The productivity paradox: A meta-analysis. *Information Economics and Policy* 38, 38-54.

Porter, M., 1998. Competitive Strategy: Techniques for Analysing Industries and Competitors. The Free Press, New York, NY.

Pradabwong, J., Braziotis, C., Tannock, J. D. T., and Pawar, K. S., 2017. Business process management and supply chain collaboration: effects on performance and competitiveness. *Supply Chain Management: an International Journal* 22(2), 107-121.

Prajogo, D., and Olhager, J., 2012. Supply chain integration and performance: The effects of long-term relationships, information technology and sharing, and logistics integration. *International Journal of Production Economics* 135(1), 514-522.

Prajogo, D., Oke A., and Olhager, J., 2016. Supply chain processes: Linking supply logistics integration, supply performance, lean processes and competitive performance. *International Journal of Operations and Production Management* 36(2), 220-238.

Preacher, K. J., Rucker, D. D., and Hayes, A. F., 2007. Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioural Research* 42(1), 185-227.

Primo, M. A., and Amundson, S. D., 2002. An exploratory study of the effects of supplier relationships on new product development outcomes. *Journal of Operations Management* 20(1), 33-52.

Raber, D., Wortmann, F., and Winter, R., 2013. Towards The Measurement Of Business Intelligence Maturity. ECIS 2013 Completed Research. Paper 95.

Rabinovich, E., Bailey, J. P., and Carter, C. R., 2003. A transaction-efficiency analysis of an internet retailing supply chain in the music CD industry. *Decision Sciences 34*(1), 131-172.

Ragatz, G. L., Handfield, R. B., and Petersen, K. J., 2002. Benefits associated with supplier integration into new product development under conditions of technology uncertainty. *Journal of Business Research* 55(5), 389-400.

Rosemann, M., and de Bruin, T., 2005. Towards a business process management maturity model. *Proceedings of the Thirteenth European Conference on Information Systems*, Regensburg, Germany, May 26-28.

Quesada, G., Rachamadugu, R., Gonzalez, M., and Martinez, J. L., 2008. Linking order winning and external supply chain integration strategies. *Supply Chain Management: an International Journal* 13(4), 296–303.

Ragatz, G. L., Handfield, R. B., and Petersen, K. J., 2002. Benefits associated with supplier integration into new product development under conditions of technology uncertainty. *Journal of Business Research* 55(5), 389-400.

Rego, A., Owens, B., Leal, S., Melo, A. I., Cunha, M. P., Gonçalves, L., and Ribeiro, P., 2017. How leader humility helps teams to be humbler, psychologically stronger, and more effective: A moderated mediation model. *Leadership Quarterly* 28(5), 639-658.

Sáenz, M. J., Knoppen, D., and Tachizawa, E. M., 2018. Building manufacturing flexibility with strategic suppliers and contingent effect of product dynamism on customer satisfaction. *Journal of Purchasing and Supply Management* 24(3), 238-246.

Salvador, F., Forza, C., Rungtusanatham, M., and Choi, T. Y., 2001. Supply chain interactions and time-related performances: An operations management perspective. *International Journal of Operations and Production Management* 21(4), 461-475.

Salvador, F., and Villena, V. H., 2013. Supplier integration and NPD outcomes: Conditional moderation effects of modular design competence. *Journal of Supply Chain Management* 49(1), 87-113.

Sancha, C., Longoni, A., and Giménez, C., 2015. Sustainable supplier development practices: Drivers and enablers in a global context. *Journal of Purchasing and Supply Management* 21, 95-102.

Sanders, N. R., 2007. An empirical study of the impact of e-business technologies on organizational collaboration and performance. *Journal of Operations Management* 25(6), 1332-1347.

Sanders, N. R., 2008, Pattern of information technology use: The impact on buyer–suppler coordination and performance. *Journal of Operations Management 26*(3), 349-367.

Sanders Jones, L., and Linderman, K., 2014. Process management, innovation and efficiency performance: The moderating effect of competitive intensity. *Business Process Management Journal 20*(2), 335-358.

Sarkar, A., and Mohapatra, P. K., 2006. Evaluation of supplier capability and performance: A method for supply base reduction. *Journal of Purchasing and Supply Management 12*(3), 148-163.

Schimmenti, A., Passanisi, A., Caretti, V., La Marca, L., Granieri, A., Iacolino, C., Gervasi, A. M., Maganuco, N. R., and Billieux, J., 2017. Traumatic experiences, alexithymia, and Internet addiction symptoms among late adolescents: A moderated mediation analysis. *Addictive Behaviors* 64, 314-320.

Schoenherr, T., and Swink, M., 2012. Revisiting the arcs of integration: Cross-validations and extensions. *Journal of Operations Management* 30(1-2), 99–115.

Schoenherr, T. and Swink, M., 2015. The Roles of Supply Chain Intelligence and Adaptability in New Product Launch Success. *Decision Sciences* 46(5), 901-936.

Schrettle, S., Hinz, A., Scherrer-Rathje, M., and Friedli, T., 2014. Turning sustainability into action: Explaining firms' sustainability efforts and their impact on firm performance. *International Journal of Production Economics* 147, 73-84.

Seo, Y., Dinwoodie, J. and Kwak, D., 2014. The impact of innovativeness on supply chain performance: is supply chain integration a missing link? *Supply Chain Management: an International Journal* 19(5/6), 733-746.

Shee, H., Miah, S. J., Fairfield, L., and Pujawan, N., 2018. The impact of cloud-enabled process integration on supply chain performance and firm sustainability: the moderating role of top management. *Supply Chain Management: an International Journal* 23(6), 500-517.

Shou, Y., Li, Y., Park, Y., and Kang, M., 2018. Supply chain integration and operational performance: the contingency effects of production systems. *Journal of Purchasing and Supply Management* 24(4), 352-360.

Solow, R. M., 1987. We'd better watch out. In: New York Times Book Review, p. 36.

Sousa, R., and Voss, C.A. 2008. Contingency research in operations management practices. *Journal of Operations Management* 26(6), 697-713.

Singhal, J., and Singhal, K., 2007. Holt, Modigliani, Muth, and Simon's work and its role in the renaissance and evolution of operations management. *Journal of Operations Management* 25(2): 300–309.

Sousa, R., and Voss, C., 2008. Contingency Research in Operations Management Practices. *Journal of Operations Management* 26: 697-713.

Stevens, G.C., 1989. Integrating the Supply Chain. *International Journal of Physical Distribution & Materials Management* 19(8): 3-8.

Springinklee, M., and Wallenburg, C. M., 2012. Improving distribution service performance through effective production and logistics integration. *Journal of Business Logistics* 33(4), 309-323.

Srinivasan, R., and Swink, M., 2015. Leveraging Supply Chain Integration through Planning Comprehensiveness: An Organizational Information Processing Theory Perspective. *Decision Sciences* 46(5), 823-861.

Swaim, J. A., Maloni, M., Bower, P., and Mello, J. 2016. Antecedents to effective sales and operations planning. *Industrial Management & Data Systems* 116(6): 1279-1294.

Swink, M., and Nair, A., 2007. Capturing the competitive advantages of AMT: Design–manufacturing integration as a complementary asset. *Journal of Operations Management* 25, 736–754.

Swink, M., Narasimhan, R., and Kim, S. W., 2005. Manufacturing Practices and Strategy Integration: Effects on Cost Efficiency, Flexibility, and Market-Based Performance. *Decision Sciences* 36(3), 427-457.

Swink, M., Narasimhan, R., and Wang, C., 2007. Managing beyond the factory walls: Effects of four types of strategic integration on manufacturing plant performance. *Journal of Operations Management* 25(1), 148-164.

Swink, M., and Schoenherr, T., 2015. The effects of cross-functional integration on profitability, process efficiency, and asset productivity. *Journal of Business Logistics* 36(1), 69-87.

Swink, M., and Zsidisin, G., 2006. On the benefits and risks of focused commitment to suppliers. *International Journal of Production Research 44*(20), 4223-4240.

Tachizawa, E. M., Gimenez, C. and Sierra, V., 2015. Green supply chain management approaches: drivers and performance implications. *International Journal of Operations and Production Management* 35(11), 1546-1566.

Tang, C. S., and Veelenturf, L. P., 2019. The Strategic Role of Logistics in the Industry 4.0 Era. *Transportation Research Part E* 129: 1-11.

Thomé, A. M. T., Scavarda, L. F., Fernandez, N. S., and Scavarda, A. J., 2012a. Sales and Operations Planning: A Research Synthesis. *International Journal of Production Economics* 138: 1–13.

Thomé, A. M. T., Scavarda, L. F., Fernandez, N. S., and Scavarda, A. J., 2012b. Sales and operations planning and the firm performance. *International Journal of Productivity and Performance Management* 61(4): 359-381.

Thomé, A. M. T., Sousa, R. S., and Scavarda do Carmo, L. F. R. R., 2014. The impact of sales and operations planning practices on manufacturing operational performance. I*nternational Journal of Production Research* 52(7): 2108-2121.

Thompson, J., 1967. Organizations in Action. McGraw-Hill, New York, NY.

Tohamy, N., Kohler, J., Pukkila, M. and Tarafdar, D., 2013. Toolkit: S&OP Maturity Self-Assessment for Supply Chain Leaders, Gartner, Inc, Stamford, CT.

Tranfield, D., Denyer, D., and Smart, P., 2003. Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *British journal of management* 14, 207-222.

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

Turkulainen, V., Kauppi, K., and Nermes, E., 2017. Institutional explanations: Missing link in operations management? Insights on supplier integration. *International Journal of Operations & Production Management* 37(8), 1117-1140.

Turkulainen, V., and Swink, M. L., 2017. Supply chain personnel as knowledge resources for innovation-A contingency view. *Journal of Supply Chain Management* 53(3), 41-59.

Vachon, S., and Klassen, R. D., 2002. An exploratory investigation of the effects of supply chain complexity on delivery performance. *IEEE Transactions on engineering management* 49(3), 218-230.

van der Vaart, T., and van Donk, D. P., 2008. A critical review of survey-based research in supply chain integration. *International Journal of Production Economics* 111(1), 42-55.

van der Vaart, T., van Donk, D. P., Gimenez, C., and Sierra, V., 2012. Modelling the integration performance relationship. Collaborative practices, enablers and contextual factors. *International Journal of Operations and Production Management* 32(9), 1043-1074.

Vanpoucke, E., Vereecke, A., and Muylle, S., 2017. Leveraging the impact of supply chain integration through information technology. *International Journal of Operations and Production Management* 37(4), 510-530.

Venkatraman, N., 1989. The Concept of Fit in Strategy Research: Toward Verbal and Statistical Correspondence. *The Academy of Management Review* 14(3), 423-444.

Venkatraman, N., and Camillus, J. C., 1984. Exploring the Concept of "Fit" in Strategic Management. *The Academy of Management Review* 9 (3), pp. 513-525.

Ventana Research. 2006. Sales and operations Planning: Measuring Maturity and Opportunity for Operational Performance Management. San Mateo, CA: Ventana Research.

Vereecke, A., and Muylle, S., 2006. Performance improvement through supply chain collaboration in Europe. *International Journal of Operations and Production Management* 26(11), 1176-1198.

Vickery, S.K., Jayaram, J., Droge, C., and Calantone, R., 2003. The effects of an integrative supply chain strategy on customer service and financial performance: an analysis of direct versus indirect relationships. *Journal of Operations Management* 21(5), 523-539.

von Haartman, R., and Bengtsson, L., 2015. The impact of global purchasing and supplier integration on product innovation. *International Journal of Operations & Production Management* 35(9), 1295-1311.

Wagner, S. M., 2011. Supplier development and the relationship life-cycle. *International Journal of Production Economics 129*(2), 277-283.

Wagner, S. M., Ullrich, K. K. R., and Transchel, S., 2014. The game plan for aligning the organization. *Business Horizons* 57: 189-201.

Wallace T. F., and Stahl, R. A., 2008. Sales and Operations Planning: The How-to Handbook, 3rd ed. Montgomery: T. F. Wallace & Company.

Wang, J. Z., Hsieh, S. T., and Hsu, P. Y., 2012. Advanced sales and operations planning framework in a company supply chain. *International Journal of Computer Integrated Manufacturing* 25(3): 248-262.

Wang, C. L., and Chugh, H., 2014. Entrepreneurial learning: past research and future challenges. *International Journal of Management Reviews* 16, 24-61.

Wang, B., Childerhouse, P., Kang, Y., Huo, B., and Mathrani, S., 2016. Enablers of supply chain integration. *Industrial Management and Data Systems* 116(4), 838-855.

Ward, P., Zhou, H., 2006. Impact of Information Technology Integration and Lean/Just-In-Time Practices on Lead-Time Performance. *Decision Sciences* 37(2), 177-203.

Wasti, S. N., and Liker, J. K., 1997. Risky business or competitive power? Supplier involvement in Japanese product design. *Journal of Product Innovation Management* 14(5), 337-355.

Wernerfelt, B., 1984. The resource-based view of the firm. *Strategic Management Journal* 5 (2), 171–180.

Wiengarten, F., Humphreys, P., McKittrick, A., and Fynes, B., 2013. Investigating the impact of e-business applications on supply chain collaboration in the German automotive industry. *International Journal of Operations and Production Management* 33(1), 25-48.

Wiengarten, F., Pagell, M., Ahmed, M. U., and Gimenez, C., 2014. Do a country's logistical capabilities moderate the external integration performance relationship? *Journal of Operations Management* 32(1-2), 51–63.

Wiengarten, F., Humphreys, P., Gimenez, C., and McIvor, R., 2016. Risk, risk management practices, and the success of supply chain integration. *International Journal of Production Economics* 171(3), 361-370.

Williams, B. D., Roh, J., Tokar, T., and Swink, M., 2013. Leveraging supply chain visibility for responsiveness: The moderating role of internal integration. *Journal of Operations Management* 171(7-8), 543-554.

Williamson, O. E., 1975. Markets and hierarchy: Analysis and antitrust implications. New York, NY: Free Press.

Wing, L., and Perry, G., 2001. Toward Twenty-First-Century Pharmaceutical Sales and Operations Planning. *Pharmaceutical Technology* 20-26.

Wong, C. Y., Boon-itt, S., and Wong, C. W. Y., 2011. The contingency effects of environmental uncertainty on the relationship between supply chain integration and operational performance. *Journal of Operations Management* 29(6), 604–615.

Wong, C. W. Y., Wong, C. Y., and Boon-itt, S., 2013. The combined effects of internal and external supply chain integration on product innovation. *International Journal of Production Economics* 146(2), 566-574.

Wong, C. W. Y., Lai, K., and Bernroider, E. W. N., 2015a. The performance of contingencies of supply chain information integration: The roles of product and market complexity. *International Journal of Production Economics* 165, 1-11.

Wong, C. W. Y., Lai, K., Cheng, T. C. E., and Lun, Y. H. V., 2015b. The role of IT-enabled collaborative decision making in inter-organizational information integration to improve customer service performance. *International Journal of Production Economics* 159, 56-65.

Wong, C. Y., Wong, C. W. Y., and Boon-itt, S., 2015c. Integrating environmental management into supply chains. *International Journal of Physical Distribution and Logistics Management* 45(1/2), 43-68.

Wong, C. W., Sancha, C., and Thomsen, C. G., 2017a. A national culture perspective in the efficacy of supply chain integration practices. *International Journal of Production Economics* 193, 554-565.

Wong, C. Y., Wong, C. W., and Boon-itt, S., 2017b. Do arcs of integration differ across industries? Methodology extension and empirical evidence from Thailand. *International Journal of Production Economics* 183, 223-234.

Wu, I., Chuang, C., and Hsu, C., 2014. Information sharing and collaborative behaviors in enabling supply chain performance: A social exchange perspective. *International Journal of Production Economics* 148, 122-132.

Wu, F., Mahajan, V., and Balasubramanian, S., 2003. An analysis of e-business adoption and its impact on business performance. *Journal of the Academy of Marketing science* 31(4), 425-447.

Yin, R.K., 2014. Case Study Research: Design and Methods. 5th ed. Thousand Oaks, CA: Sage.

Zacharia, Z. G., Nix, N. W., and Lusch, R. F., 2011. Capabilities that enhance outcomes of an episodic supply chain collaboration. *Journal of Operations Management 29*(6), 591-603.

Zhu, Q., Krikke, H., and Caniëls, M. C., 2018. Supply chain integration: value creation through managing inter-organizational learning. *International Journal of Operations and Production Management* 38(1), 211-229.

Zhu, Q., Sarkis, J., and Lai, K. H., 2013. Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices. *Journal of Purchasing and Supply Management* 19, 106-117.