



# **Supply Chain Integration and Performance: Empirical essays in a manufacturing context**

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Deinze; September 12, 2009

Evelyne Vanpoucke

‘The least attractive way to try to win on a global basis is to think you can take on the world all by yourself’ (Jack Welch, CEO GE).

## Abstract

This dissertation aims at understanding how supply chain integration, and its broader context of interorganizational strategic alliances, impacts performance. While the literature is stating that the most admired and feared competitors today are companies that link their customers and suppliers into tightly integration networks, previous studies showed a positive, but rather weak link, between supply chain integration and performance. Moreover, some empirical studies even showed that supply chain integration is no guarantee for success. Consequently, other factors are influencing this link between supply chain integration and performance. Based on this statement, we looked at some other variables such as behavioural characteristics, contextual variables and the development of alliances that might impact the link between supply chain integration and performance.

More specifically, the aim of this dissertation is to (1) assess the predictive value of behavioural characteristics of strategic alliances on operational performance, (2) reveal some of the contextual contingencies of these strategic alliances (3) test the notion of supply chain integration as a dynamic capability and (4) understand how these strategic alliances develop and transform over time.

To understand these complex relationships between supply chain integration and performance, we combined multiple data sources and research techniques. The research methodology literature is describing this research technique as a mixed-method design, which uses both qualitative and quantitative studies. Furthermore, the quantitative results are used to guide the sampling of our qualitative research.

Based on a framework for measuring the success of strategic alliances in the literature, our first objective is to assess the predictive value of three behavioural characteristics, i.e. alliance attributes (such as trust, interdependence and coordination), communication behaviour (i.e. information sharing, participation and quality) and alliance management (i.e. supply chain leadership and process thinking) on the operational performance. Our analyses clearly show that all three behaviour characteristics impact the operational performance and that the alliance attributes are the main predictor. Furthermore, these alliances show us how or in other words via which operational performance variables, these behavioural characteristics impact performance: by decreasing costs in the supply chain or by creating better services towards the partner.

A second study identifies different levels of supply chain integration based on the information flow characteristics between the partners. Furthermore, we looked at the differences in relational, contextual and performance variables of these different levels of supply chain integration. Our analysis shows that highly integrated supply chains have high levels of trust and interdependence and that the difference between low and medium levels of supply chain integration co-varies with the level of trust. As such, this data shows that we first need to build up trust to share information and only think about implementing structures to share this information in later stages. Furthermore, the study shows that supply chain technologies are not replacing the traditional ways of communication between the partners, but are an additional medium which enables companies to integrate the information of the two parties.

A third study measures supply chain integration capability as a dynamic capability, containing (1) different processes of information sharing to capture changes in supply and/or demand, (2) procedures to detect these changes and (3) transformation processes to solve supply or demand problems. This study measures integration as consisting of these three sub-capabilities (in contrast with previous studies which only measure one or two of the sub-capabilities) and shows that there is a significant impact on performance if companies score high on all three sub-capabilities.

Finally, our last study is describing the development process of five supplier alliances. We describe the five cases in terms of evolution, the triggers for more integration and, relationship and product characteristics. Our results show that managing these alliances is a complex process and requires continuous efforts from both parties in the relationship. Furthermore, the data

suggests three important integration activities in supplier alliances: operational, relational and financial integration. Each of these are triggered through different managerial decisions such as supplier reduction programs, process improvement programs and/or risk management programs.

As a whole, this dissertation contributes to a better understanding of the supply chain integration construct and its impact on performance. This dissertation adds in a multidisciplinary way to the existing literature, by blending insights of supply chain management, strategy and behavioural aspects. From a business perspective, added value is provided by showing how and under which conditions supply chain integration might increase the operational performance of the alliance.

# Samenvatting

Ondanks er vaak gespeculeerd wordt dat bedrijven die sterk geïntegreerd zijn met klanten en leveranciers beter presteren, vonden onderzoekers slechts een matig positieve impact van supply chain integratie op performantie. Dit doet ons vermoeden dat er andere factoren aan de basis liggen die de link tussen supply chain integratie en performantie beïnvloeden. De doelstelling van dit doctoraat is dan ook om na te gaan welke deze factoren zijn en welke factoren er m.a.w. kunnen voor zorgen dat supply chain integratie tot verhoogde prestaties leidt.

De doelstelling van dit doctoraat kan onderverdeeld worden in volgende vier onderzoeksobjectieven: (1) nagaan wat de invloed is van management- en gedragskarakteristieken van de supply chain alliantie op de operationele prestaties, (2) begrijpen hoe omgevingsfactoren de supply chain alliantie beïnvloeden, (3) het testen van de notie van ‘supply chain vaardigheid’ en (4) nagaan hoe deze allianties zich ontwikkelen.

Om deze complexe relatie tussen supply chain integratie en performantie te bestuderen, verzamelden we meerdere datasets en maakten we gebruik van verschillende onderzoekstechnieken. Zowel kwalitatieve als kwantitatieve onderzoekstechnieken werden aangewend, waarbij de kwalitatieve onderzoekstechnieken tot doelstelling hadden om datgene wat we vonden verder te verklaren aan de hand van case studies.

In een eerste studie, gebaseerd op een raamwerk van Mohr en Spekman (1994) en Monczka et al. (1998), hebben we de impact van een aantal management- en gedragskarakteristieken bestudeerd bij supply chain allianties. Deze karakteristieken werden onderverdeeld in drie groepen van karakteristieken: alliantie attributen (vertrouwen, afhankelijkheid en coördinatie), communicatiegedrag (communicatie kwaliteit, informatie participatie en informatie uitwisseling) en management technieken (proces denken en leiderschap). De eerste studie wil dan ook nagaan



wat het effect is van elk van deze individuele karakteristieken op performantie en hoe deze karakteristieken de performantie beïnvloeden (i.e. via welke operationele verbeteringen: service verbeteringen of kostenreducties).

Een tweede studie identificeert verschillende niveaus van informatie uitwisseling in de supply chain. Vervolgens wordt ook nagegaan of deze verschillende niveaus van informatie uitwisseling gelinkt kunnen worden met bepaalde relationele en contextuele situaties en bepaalde niveaus van supply chain integratie. Deze studie toont aan dat het uitwisselen van informatie enkel mogelijk is wanneer er voldoende vertrouwen is tussen beide partners. Verder geeft deze studie ook aan dat supply chain technologieën niet de traditionele informatie uitwisselingskanalen vervangen, maar eerder een additioneel kanaal vormen die informatie participatie mogelijk maakt.

Studie drie test de notie van ‘supply chain vaardigheid’. Hierbij wordt niet enkel gekeken in hoeverre ondernemingen integratiepraktijken uitvoeren, maar ook naar de mate waarin bedrijven in staat zijn om te reageren op veranderingen in de supply chain. De studie toont dan ook aan dat bedrijven die deze vaardigheden van (1) detecteren van veranderingen in de supply chain (2) procedures om signalen op te vangen en te vertalen in acties en (3) ervaring hebben in het uitvoeren van supply chain integratie projecten, in staat zijn om hun performantie aanzienlijk te verhogen.

De laatste studie van het doctoraat bekijkt ten slotte supply chain integratie aan de hand van case studies. Hierbij worden vijf trajectories beschreven van bedrijven die nauw geïntegreerd zijn. Deze studie bevestigt een aantal van voorgaande bevindingen in case studies en laat ons toe om het ‘hoe’ en ‘waarom’ beter te begrijpen. Deze studies beschrijven dan ook de motivatie van bedrijven om meer te integreren en beschrijven de evolutie naar meer integratie als een cyclisch proces waarbij het belangrijk is dat beide partners blijven investeren.

We kunnen dus besluiten dat dit doctoraat betere inzichten verschaft over de impact van supply chain integratie op performantie en de rol die management- en gedragstechnieken en omgevingsfactoren hierin spelen.

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**Part I:**  
**General Introduction**



# Chapter 1: Introduction and research objectives

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In this first chapter, we will discuss the general research objectives underlying this doctoral dissertation. We start with highlighting the importance of strategic alliances in the current organizational context. This is followed by a review of the literature on strategic alliances and its main aim: creating an integrated and synchronized supply chain. We will provide definitions for the terms used and explain the framework for this doctoral thesis. Based on the literature review, we will then identify the research gaps and eventually present the general research objectives for the doctoral dissertation. We conclude by providing an overview of the structure of the doctoral dissertation.

Keywords: strategic alliances, supply chain integration, performance improvement

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## **1.1 Strategic alliances in a supply chain context**

The emergence of low-cost information sharing has made it possible for manufacturers to change the way they operate and distribute information throughout their organizations. Through the use of ERP systems, these firms can operate with lower levels of inventory and can respond more quickly to changes in requirements. However, firms have made much less progress in improving the efficiency of the production and information flows between their own plants and those of their suppliers and customers. A lack of communication between supply chain partners is reducing this potential for inventory and expense savings, as well as leading to duplication of effort and investment in non-ideal information processes in the supply chain.

From a managers' perspective, setting up these communication systems and procedures to coordinate production and information flow is a difficult undertaking. It requires effort, time and willingness of both partners. Furthermore, the heightened environmental complexity and the behavioural characteristics of such a strategic alliance (see definition section 2) make this task even more complex. Consequently, we can state that some of the success of strategic

alliances is attributable to the way in which integration practices are combined and organized, rather than just the nature of the practices themselves.

The aim of this doctoral dissertation is therefore to examine the impact of integration practices and behavioural characteristics of strategic alliances on the operational performance of the supply chain partners.

In what follows, we provide a selective review of empirical research on strategic alliances in a supply chain context. It is not our intention to provide a comprehensive overview of the literature. The four papers presented in chapters 3 to 6 will provide a more complete and in-depth discussion of the relevant literature. Given the importance of the concept of the strategic alliance and supply chain integration in all four empirical studies reported in this dissertation, we first provide a definition of these concepts. We also develop an overall framework of the dissertation, supported by the literature (see Figure 1.1).

## **1.2 Strategic alliances and supply chain integration: definition and framework**

The term inter-organizational relationships spans both contractual and equity arrangements (Yoshino and Rangan 1995) and includes strategic alliances, franchises, research consortia and various forms of network organizations. The domain of strategic alliances, as described in the literature, spans some of the contractual arrangement (i.e. the nontraditional contracts) and some equity arrangements (i.e. arrangement with no new equity and with creation of equity) (Yoshino and Rangan 1995). An overview of the range of inter-organizational relationships and the concept of strategic alliances can be found in Appendix A. Since we believe that the way in which partners are brought together (i.e. contractually or through equity arrangements) may influence integration practices, information flows and behavioural characteristics, this doctoral dissertation focuses only on strategic alliances based on nontraditional contractual arrangements. Based on the definition of Yoshino and Rangan (1995), strategic alliances, which are different from simple buy-sell contractual arrangement, require the following necessary and sufficient conditions: (1) independence of the parties, (2) shared benefits among the parties and, (3) ongoing participation in one or more key strategic areas, such as technology, products, markets, etc. Consequently, we describe strategic alliances as “long-term cooperative relationships designed to increase the strategic operating capability of two individual firms, with the aim of achieving significant benefits to both

parties. These alliances will last provided that they continue to offer significant value to each of the parties. Some of the main benefits of this type of relationships are the increase in the synchronization of the supply chain, the reduction of total costs, improvement of quality and cycle times, as well as a strong competitive position which exceeds any possible contribution from traditional relationships (Monczka et al. 1998).” For this dissertation (and as you can see from our definition), however, we only study strategic alliances which include some component(s) of supply chain integration (i.e. logistics, purchasing and/or operations; see non-traditional contracts in Bold in Appendix A). Other strategic alliances focussing only on for instance R&D collaboration or an integrated sales proposition are in other words not included.

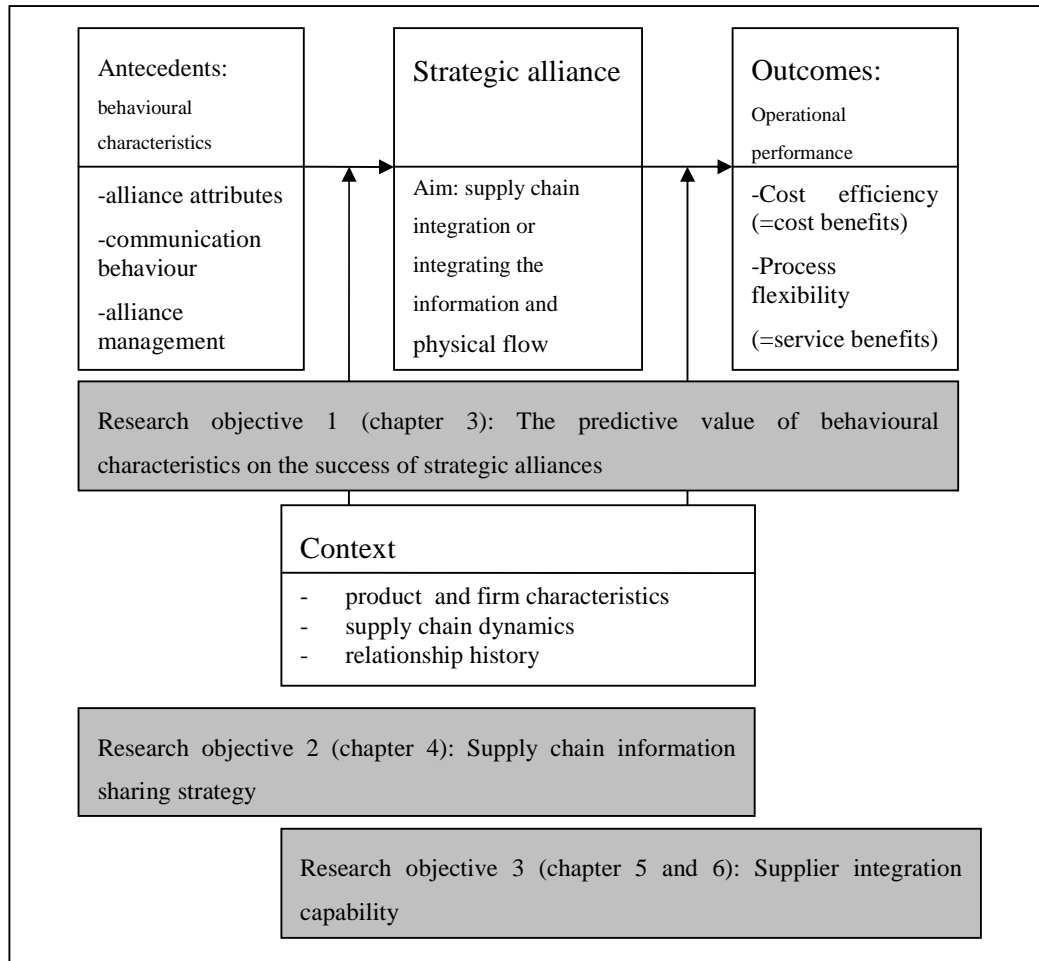
Furthermore, the literature also makes a distinction between horizontal and vertical alliances (e.g. Achrol 1997, Yoshino and Rangan 1995). While horizontal alliances focus on working together with competitors, vertical alliances describe an alliance of a company with its supplier or customer. The focus of this dissertation is on vertical alliances or what we call the supply chain.

Figure 1.1 represents the overall framework and the different constructs of this doctoral dissertation. Central to this doctoral dissertation is the concept of strategic alliances and its main aim of integrating the information and physical flow in the supply chain. While strategic alliances include the total set of operational, tactical and strategic integration activities, supply chain integration specifically focuses on the operational and tactical processes of integrating the physical and information flow as defined by Frohlich and Westbrook (2001) and Sahin and Robinson (2002). These supply chain integration practices include for instance information sharing between the partners, but also joint supply and demand planning, joint inventory management (e.g. VMI systems), collaborative forecasting or even decisions to locate the plant next to a customer or a supplier to improve the delivery. As such, the concept of strategic alliances is broader than just integrating the operational and tactical processes of the information and physical flow and might also include organizations to strategically work together or see supply chain integration as a part of the overall integration activities.

Furthermore, the framework shows that the integration of the information and physical flows is influenced by the behavioural (antecedents) and contextual characteristics of the strategic

alliance. Finally, these strategic alliances influence the operational performance of the strategic alliance.

**Figure 1.1:** Framework of the doctoral dissertation



Previous research has contributed significantly to our understanding of some of the different aspects of the framework of strategic alliances. In the next section, we describe the different general constructs of our framework and review the main conclusions that can be derived from the literature. Furthermore, we identify three important research gaps.

## **1.3 Synthesis of the literature and research objectives**

### **1.3.1 Supply chain integration**

A strategic alliance recognizes that integrated business processes create value for the firm's customers and that these processes reach beyond the boundaries of the firm by drawing suppliers and customers into the value creation process (Tan et al. 1998). The theoretical foundation for supply chain integration can be traced to the value chain model (Porter 1985), and specifically, its notion of linkages. Porter advocates the identification and strategic exploitation of these horizontal and vertical linkages. Optimizing these vertical linkages with suppliers and customers is the core of supply chain management.

The literature suggests that there are two interrelated forms of supply chain integration for strategic alliances. The first type of integration involves coordinating and integrating the forward physical flow of deliveries between suppliers, manufacturers, and customers. The other prevalent type of integration, called supplier alliances, involves the backward coordination of information flows from customers to suppliers. These information flows allow multiple organizations to coordinate their activities and physical flows in an effort to truly manage the supply chain (Handfield and Nichols 1999, Frohlich and Westbrook 2001).

Supply chain integration, which is the core aim of strategic alliances for supply chain improvement, focuses on the tactical and operational processes and is thus defined as the processes or routines of acquiring and sharing information with a supply chain partner and the practices and procedures in place to handle this information and to support the physical flow (Swink et al. 2007, Carr and Pearson 1999).

### **1.3.2 The behavioural characteristics of strategic alliances**

While the behavioural characteristics of strategic alliances have been explored in the literature, an understanding of how these behavioural characteristics are associated with operational performance is under-studied. Since it is not always clear which elements determine whether a strategic alliance is successful, insights in how these characteristics influence performance might help to prescribe the formation and conditions of successful strategic alliances. Furthermore, it might help companies to aid in the selection of partners as well as in the on-going management of alliances.

Previous research also draws on several theoretical bases to examine this issue. First, the resource-based perspective is used to build support for a configurational view of integration, suggesting that it is not the impact of isolated practices that matters but the performance synergies that emerge from specific collections of practices. Furthermore, the literature on strategic alliances has posited theories, such as transaction cost analysis (Williamson 1981, 1985), competitive strategy (Porter 1980), resource dependence (Pfeffer and Salancik 1978) and social exchange theory (Anderson and Narus 1984), addressing the reasons why firms enter into closer business relationships. Each of these theories makes predictions about when strategic alliances will be formed, but they do not predict the success of individual strategic alliances.

Both Mohr and Spekman (1994) and Monczka et al. (1998) tested a framework to explain the success of strategic alliances. While Mohr and Spekman (1994) looked at strategic alliances between manufacturers and downstream partners, Monczka et al. (1998) tested a similar model of manufacturers with upstream partners. Both models tested the impact of the behavioural characteristics on the success of strategic alliances by using simple linear regression. However these studies tested the impact of each single behavioural characteristic such as for instance the alliance attributes on success, and not as a more comprehensive model with multiple behavioural characteristics such as alliance attributes, communication behaviour and alliance management impacting performance.

Consequently, it is not yet clear how performance is influenced by the different behavioural characteristics. While previous studies mainly focused on financial performance, market performance or satisfaction, we decided to look at first-order performance measures (i.e. intermediate performance measures impacting performance), which will enable us to better understand how (i.e. via which manufacturing capabilities) the behavioural characteristics impact firm performance. In our study, we will assess the influence of each behavioural characteristic on both service and cost benefits associated with the alliance. As suggested by Yang (2009), researchers should investigate the connection between behavioural characteristics and alliance performance. This study is a first attempt to do so. Our first research objective is thus:



**Research objective 1:**

In order to increase our understanding of the importance of the behavioural characteristics of strategic alliances, the first objective of this doctoral dissertation is *to assess the predictive value of behavioural characteristics of strategic alliances on operational performance.*

**1.3.3 The context of strategic alliances**

Although the number of studies on behavioural and contextual antecedents of strategic alliances is growing rapidly, these studies seem to develop in isolation from each other. Notwithstanding some notable exceptions (e.g. Zhou and Benton 2007, Johnston et al. 2004), few studies have tested more integrative frameworks, including both behavioural and contextual antecedents. Given that the context influences the potential success of strategic alliances, a general model, as provided in our first research objective, oversimplifies the context in which the strategic alliance is set up. Consequently, we need to include not only behavioural, but also contextual characteristics in our research.

The literature describes some important contextual variables in supply chains. Information processing theory for instance supports the influence of supply chain dynamics on information flow (Galbraith 1974, Zhou et al. 2007). Supply chain dynamics is defined in the literature as unpredictable changes in products, technologies and demand for products in the market (Miller and Friesen 1983, Zhou and Benton 2007). As supply chain dynamics increases, information processing capacity needs to be increased in order to achieve superior firm performance. Fisher (1997) suggests that supply chains facing a different level of supply chain dynamics should use different supply chain practices. Based on these theories, we can state that product (e.g. volatile versus stable demand) and market (e.g. level of competitiveness, foreign competition) characteristics influence the information flows between partners in a supply chain. As such, our second research objective is to look at some of these contingencies in strategic alliances:

**Research objective 2:**

Given the importance of behavioural as well as contextual characteristics of strategic alliances, the second objective of this doctoral dissertation is *to reveal some of the contextual contingencies of strategic alliances.*

### 1.3.4 The dynamics of strategic alliances

#### 1.3.4.1 Creating an integration capability by focusing on learning processes

Different categorization schemes have been applied in OM research so as to isolate the effectiveness of different integration efforts. Integration can refer to anything from information sharing to collaborative forecasting to strategic planning. Studies falling under the supply chain integration area have examined the effects of these types of integration. Often, they have considered supply, supply chain, and customer integration resources to either directly or indirectly contribute to performance aspects of the focal firm. The work of these OM researchers has concentrated on confirming the positive link between the level of one or more types of supply chain integration and the performance of the focal firm (e.g. Swink et al. 2007, Vereecke and Muylle 2006, Frohlich and Westbrook 2001).

However, we believe that a firm that seeks the benefits of integration is not necessarily best served by integrating in all manners. Rather, it should consider the integrative capabilities that a particular type of integration can enable. Even if ignoring capabilities were advisable, justifying integration efforts within a firm requires tying integration types to capabilities so that the direct benefits can be understood. After all, an integration practice does not have value in and of itself. Its value is derived from the integrative capabilities it enables, and these are what managers seek to achieve when they implement practices. Based on a framework of Teece (2007), we describe an integration capability as a dynamic capability consisting of sensing, seizing, and transforming sub-capabilities. As such, our third research objective is to empirically test this notion of integration capability as a dynamic capability:

#### **Research objective 3:**

Given that strategic alliances are dynamic processes, our third objective is to *model integration as a dynamic capability including 'transformational processes'*.

#### 1.3.4.2 The development of strategic alliances

We believe that case studies can provide us additional insights in describing the dynamics and more specific the development process. Furthermore, it helps us to explain some of our previous findings in a more practical setting. While our second study described contingencies in strategic alliances according to the relational characteristics (i.e. trust and interdependence) and the use of structured integration practices, it is not clear yet whether these different types

of strategic alliances are the result of measuring strategic alliances at different development stages (where one stage is the pre-integration stage while the other one the integration phase) or whether these are really different types of strategic alliances, which can be explained by contingencies. Furthermore, the case studies help us to understand the longer term dynamics of strategic alliances by describing how strategic alliances develop over time. Our final objective can thus be stated as:

**Research objective 4:**

Given that strategic alliances evolve over time, our fourth objective is to understand *the development process of strategic alliances*.

This list of avenues for research is by no means comprehensive. Our aim was to focus on our research objectives as derived from our framework and from previous research. Nevertheless, we believe that this introduction chapter offers some general entry points into the literature which will guide us during this manuscript.

## **1.4 Overview of the chapters**

**Part I** To address the research objectives as described, we conducted four empirical studies. The data for these studies were collected in three separate research projects. In chapter 1 of part I, we described the research objectives of the dissertation. In chapter 2, we will describe the samples and the data collection methodology used for this doctoral dissertation. This will enable the reader to sense the context of our studies.

**Part II** In the second part of this dissertation, we will use an essay format to present the four studies we conducted.

In chapter 3 (paper 1), we will address the first research objective of this dissertation: ‘Assessing the predictive value of behavioural characteristics on the success of strategic alliances’. We report here the results of a study measuring three different behavioural characteristics and how these characteristics influence service and cost benefits of a strategic alliance.

The second research objective of this doctoral dissertation is the focus of chapter 4 (paper 2). This paper, titled ‘Supply chain information flow strategy: an empirical taxonomy’, describes how strategic alliances integrate their information flows and how this is influenced by contextual factors such as business context and behavioural aspects.

In Chapter 5 (paper 3) and 6 (paper 4), we focus on the third objective of the doctoral dissertation which is to explain the dynamics of strategic alliances. Chapter 5, a paper with the title 'Supplier Integration Capability: a conceptualization and test', presents and tests the notion of supplier integration capability as a dynamic capability. The fourth and final essay, in Chapter 6, presents the results of 5 cases of how strategic alliances have developed over time. The title of this paper is 'From buy-sell relationships to supplier alliances: Towards a dynamic life-cycle theory'.

**Part III** Finally, in chapter 7, we will discuss the theoretical contributions of this doctoral dissertation across the four empirical studies. Specifically, we highlight how the results reported in this doctoral dissertation contribute to the literature on strategic alliances and supply chain integration. Furthermore, we conclude with some practical learning points for managers.

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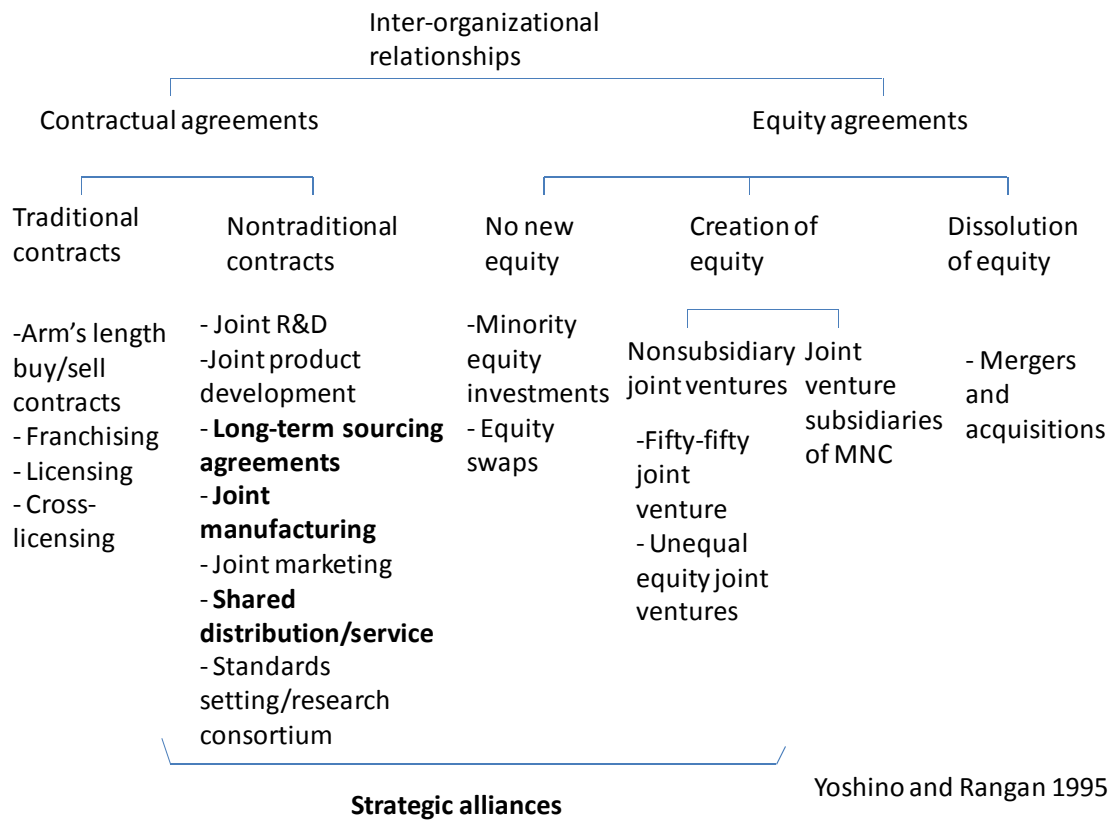
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## Appendix

### Appendix A: Range of inter-organizational relationships



# Chapter 2:

## Introduction to the empirical studies

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The previous chapter introduced the three objectives of the doctoral dissertation. To address these objectives, we conducted four empirical studies, which are reported in chapter 3 to 6. The aim of this second chapter of the doctoral dissertation is then to describe the general context of the dissertation. More specifically, we will describe the dissertation's overall methodology: a mixed-method design. We will also report information on the sample of each of our studies and explain how we collected the data.

Keywords: methodology, mixed methods, empirical studies

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### **2.1 General methodology**

The main aim of this doctoral dissertation is described in chapter 1 as: (1) assess the predictive value of behavioural characteristics of strategic alliances on operational performance, (2) reveal some of the contextual contingencies of these strategic alliances, (3) test the notion of integration as a dynamic capability and, (4) understand how these strategic alliances develop and transform over time.

Strategic alliances are a complex phenomenon. To understand these complex relationships and make inferences about these complexities, we believe that multiple techniques should be combined. Therefore, we need a variety of data sources and analyses to better understand this phenomenon. Mixed-method designs can provide this by capturing coarse-grained (survey) as well as finer grained (case study) insights. More specifically, while the first three studies aim to confirm our hypotheses on the relationship between behavioural characteristics, integration practices, contextual variables, and performance, we also want to know 'how' and 'why' these relationships happen, which was the aim of the fourth study. This means, we also conducted case studies on integration practices to help us to explore these relationships (Eisenhardt 1989).

The literature describes this combination of quantitative and qualitative research as mixed-model design. This mixed-model design allows us to simultaneously confirm a quantitatively derived

hypothesis and explore in greater depth the processes by which the relationship occurred (Tashakkori and Teddlie 2003).

This mixed-model design has some clear advantages. The main advantage of this method is that it provides better and stronger inferences. Several authors (e.g. Creswell 2002, Greene and Caracelli 1997, Brewer and Hunter 1989) have postulated that using mixed methods can offset the disadvantages that each of the methods have by themselves. While one method gives greater depth, the other will give greater breadth and together they may give results that enable researchers to make better inferences. Greene et al. (1989) provides additional support for the usefulness of these mixed methods by describing five functions for such methods: triangulation, complementarity, development, initiation, and expansion. The first two functions of mixed methods (triangulation and complementarity) are related to the fact that mixed methods lead to multiple inferences that confirm or complement each other. The latter three functions (development, initiation, and expansion) are more related to mixed method studies in which inferences made at the end of one study lead to the questions of the following study. Consequently, we use a mixed-method design in this dissertation to make better inferences by using multiple data sources and data analysis techniques. Furthermore, the outcomes of one study raised questions and helped us to formulate the objectives of the next study. The logic for this is described in chapter 1. Study 1 for instance measured the predictive value of the behavioural characteristics on performance. However, the main limitation of this study was that we did not take contextual factors into account. As such, a second study focussed on these contextual issues. In the second study, we defined three clusters of information flow strategies and looked for contingencies. However, we could not determine whether these clusters are the result of different stages of a development process of a strategic alliance or are rather due to contingencies. Consequently, study four described the development process of strategic alliances.

## **2.2 Overview of the empirical studies**

The data of the four empirical studies were collected within the scope of three larger research projects. As shown in Table 2.1, the data for the first two empirical studies were collected in



Belgian companies involved in strategic alliances with suppliers and/or customers. The data for the third empirical study are collected in an international setting and focus more on the integration practices. The third research project finally consists of descriptions of 5 supplier alliances of Belgian manufacturers with a supplier. While the first two studies focus on supply chain alliances (i.e. with both suppliers and customers), the third and fourth study are more specific and focus on supplier alliances. Specific details about the theoretical models, research designs and measures of the three studies can be found in chapter 3 to chapter 6.

Table 2.1: Overview of research projects

Project	Sample	Study	Method
1	Belgian manufacturers involved in strategic alliances with suppliers and/or customers	<u>Study 1/ research objective 1 (chapter 3):</u> The predictive value of behavioural characteristics on the success of strategic alliances  <u>Study 2/ research objective 2 (chapter 4):</u> Supply chain information flow strategies	Cross-sectional study
2	International manufacturers in the metal products, machinery and equipment industry	<u>Study 3/ research objective 3 (chapter 5):</u> Supplier integration capability	Cross-Sectional study
3	Supplier alliances of Belgian manufacturers in the food or electronics industry and its supplier	<u>Study 4/research objective 4 (chapter 6):</u> From buy-sell relationships towards supplier alliances	Case Studies

### 2.2.1 Research project 1 (study 1 and 2)

**Data collection** The target companies for the first research project consist of manufacturing companies in Belgium involved in strategic alliances. Data were collected during the second half of 2006 and beginning of 2007. The unit of analysis is a strategic alliance of a principal company with a supplier or customer.

The targeted informants for the study were supply chain managers, logistics managers, and purchasing managers from companies with more than fifty employees. This choice was made to focus on managers with appropriate supply chain knowledge and companies of sufficient size to be likely to employ supply chain information flow strategies. An initial contact list of 300 manufacturing companies was randomly developed from the Customer Relationship Management database of the sponsoring university. This database consists of an extensive list of supply chain managers who participated in executive education programs. We were thus able to select participants based on their function and company. An initial effort was made to contact participants to request their participation in the study, with the result that 200 managers agreed. Furthermore, the initial contact helped us to identify those companies and their managers that worked closely together with suppliers and/or customers and as such were in our target group. The next step was to send the questionnaire to all participants via e-mail. Following Dillman's (1978) total design method for survey data collection, follow-up phone calls have been made in order to maximize the response rate. The final results included 56 respondents or 112 strategic alliances, for a response rate of 18.7% of the initial contact sample of 300 managers.

We asked our respondents to describe both a most successful and a least successful strategic alliance. This is different from most other research focusing only on successful alliances (e.g. Johnston and Kristal 2008).

We also allowed respondents to decide whether to focus on supplier or customer strategic alliances, since we believe that few managers have in-depth experience with both supplier and customer alliances. We believe this leads our respondents to give more accurate responses than when asked to simultaneously fill out a survey for both an upstream supplier and a downstream customer as in Frohlich and Westbrook (2001). Of the 112 strategic alliances, 34 alliances focused on customer-alliances (downstream) and 78 focused on supplier-alliances (upstream).

The data were thus gathered cross-sectionally, i.e. the study variables were measured at one point in time. As such, the nature of our data makes drawing causal inferences difficult (Singleton and Straits 1999).

More information on the final sample can be found in Chapter 3 and Chapter 4.

**Survey design** Where possible, the scales are based upon existing scales in the literature. Pre-testing of the questionnaire was conducted using a sample of 10 experts (academics and people

in the field). The pre-testing provided support for the face validity of the constructs and resulted in a few minor changes in wording and presentation of items. The questionnaire was administered in English to prevent possible interpretation errors.

**Analysis of the data** To test our first research hypotheses (study 1), we used Partial Least Squares (PLS). This technique enabled us to first measure the measurement properties of our scales and then assess the predictive value of the behavioural characteristics on operational performance. The second research question (study 2) used cluster analysis to develop a taxonomy of supply chain information flows and to look for differences in contextual and behavioural characteristics in these clusters.

### **2.2.2 Research project 2 (study 3)**

**Data collection** We used the data on supplier integration and performance collected within the fourth edition of the International Manufacturing Strategy Survey (IMSS IV). This data collection was carried out in 2005 by a global network of researchers. We contributed the Belgian data to the global database.

This project, originally launched by the London Business School and Chalmers University of Technology, studies manufacturing and supply chain strategies within the assembly industry (ISIC 38) through a detailed questionnaire administered simultaneously in different countries by local research groups.

The sample of IMSS is purposefully biased towards excellent, best practice firms within each country, indicating that the firms in the sample will be the most known firms, the best performing ones (e.g. on profit), and the ones that have more international visibility, the ones that are more representative of the specificity and strengths of the country.

The questionnaire was completed by operations, manufacturing, and technical managers of the firm. In some cases (for the medium-sized firms for instance) the general manager answered the survey.

Dillman's (1978) total design method for mail survey research was followed and data from 711 firms were collected from 23 countries. Worldwide, 5787 firms were contacted by phone and asked to fill in the questionnaire. Prior to sending out the questionnaire, all countries, with the exception of Greece, first made phone calls to ask respondents whether they were willing to fill

in the questionnaire. This technique has been successfully applied in previous research and is known to increase response rates (Zhao et al. 2008). 4251 respondents agreed to participate in the research project and were sent a questionnaire. 760 answers were returned of which 711 were valid, after excluding the responses with too many missing variables. This resulted in a response rate of 18% (or 17%, if only the valid answers are taken into consideration) on the sent questionnaires. These response rates are acceptable, given that we are contacting managers in higher positions.

**Survey design** Five-point Likert scales are used in the IMSS survey. For some of the data (financial and market performance), objective figures were asked of the respondents.

**Analysis of the data** Structural equation modeling is used to test the proposed model. First, the validity and reliability of the measurement model is tested. In a second phase, these measures are then used to test the structural model.

### **2.2.3 Research project 3 (study 4)**

**Data collection** While the previous two research projects were based on large datasets of perceptual data, our third research project consists of qualitative data. As mentioned in the general research methodology, this qualitative data analysis is used to test and explain some of the findings of our previous 3 studies.

We collected data on 5 supplier alliances. As in study 3, we decided to focus only on supplier alliances. Two industries were selected for our data collection: the food and the electronics industries. The reason for choosing these industries is the difference in supply chain dynamics in the two industries. While the food industry is rather a stable industry, the electronics industry is more dynamic in nature. For more information on this choice, we refer to chapter 6.

We targeted companies in these two industries by selecting them out of the top 1.500 companies in Belgium. As such, we selected larger firms in Belgium. We phoned the companies and asked them whether they had set up integrative practices with their suppliers and whether they were willing to share this data. Furthermore, we sent them a document with the requirements of the study and we tested, based on a questionnaire, whether these reported integrative practices alliances could be categorized as ‘system intensive alliances’ as found in study 2. Based on this information, we decided to move forward with 5 supplier alliances.

Interviews were conducted with different people from the buying company and the supplier. At least 3 people involved in the supplier alliance were interviewed for each of the cases.

**Analysis of the data** We coded the interviews and used our coding to describe our findings. Nvivo is used to analyse the similarities and differences between the interviewees in a structural way.

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Part II:  
Empirical Essays





# Chapter 3: The predictive value of behavioural characteristics on the success of strategic alliances

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An increasing number of companies are setting up strategic alliances with suppliers and customers. However, the majority of these alliances do not succeed. Our aim is to understand how different behavioural characteristics are associated with alliance success. We hypothesize that alliance attributes, communication behaviour and alliance management are predictors of cost and service benefits. Furthermore, we found that while alliance attributes are related with both cost and service benefits, communication behaviour and alliance management are only associated with service and cost benefits respectively. We also see that alliance attributes explain most of the variance of supply chain success and are thus better predictors of alliance success than other behavioural characteristics. Furthermore, we provide insight into the way managers can build up supply chain performance by setting up strategic alliances.

Keywords: Strategic alliances, Supply chain management, Operational performance

This chapter is a paper forthcoming in the International Journal of Production Research.

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## 3.1 Introduction

Although the fundamental importance of supply chains is widely accepted (e.g. Saunders 1997, Gattorna 1997) and there exists a rich continuum of strategies for alliances amongst supply chain partners (Holweg et al. 2005), little is known about the magnitude of the different behavioural characteristics driving performance improvements of these alliances. Moreover, some recent studies point out that supply chain alliances are no guarantee for success (D'Avanzo et al. 2003, Holweg et al. 2005, Vereecke and Muylle 2006). This calls for an investigation of the relationship between the success of strategic alliances in the supply chain and the behavioural characteristics of these alliances.

As described by previous researchers (e.g. Vickery et al. 2004, Stevens 1989, Tan et al. 1998), managers recognize that integrated business processes (not individual functions or systems) create value for the firm's customers and that these processes reach beyond the boundaries of the firm by drawing suppliers and customers into the value creation process. Building on the work of Mohr and Spekman (1994) and Monczka et al. (1998), who described alliance success, we identified three key antecedents of strategic alliances in a supply chain context: Alliance attributes, Behavioural communication and Alliance management. Since previous research only measured the impact of the individual behavioural characteristics (e.g. Alliance attributes like trust, interdependence, coordination and commitment) on alliance success, no information is yet available on the predictive value of the three behavioural characteristics (Alliance attributes, Behavioural communication and Alliance management) on alliance success. Our objective is thus to identify which behavioural characteristic explains most of the supply chain performance improvements.

The formation of strategic alliances in a supply chain context is motivated primarily by the potential gains in competitive advantage in the marketplace (Mohr and Spekman 1994). These strategic alliances enable the partners to create economies of scale in joint production and to optimize the production and logistic processes between the partners. However, some studies claim that the rate of success in developing these integrated processes is rather low (e.g. Holweg et al. 2005). Furthermore, it is not clear how performance is predicted by the different behavioural characteristics. In our study, we will assess the influence of each behavioural characteristic on both the service and cost benefits associated with the alliance. This will enable us to gain more insight into the benefits of strategic alliances. As suggested by Yang (2009), researchers should investigate the connection between the behavioural characteristics and the alliance performance. This study is a first attempt to do so. Our aim is thus to test the predictive value of the different behavioural characteristics on both Cost and Service benefits. Furthermore, we will expand the research framework (i.e. by introducing 'alliance management' in the framework and by looking at operational performance (i.e. cost and service)) of Mohr and Spekman (1994) and Monczka et al. (1998) and we will test its applicability in a different geographical context (Europe versus the U.S).

We begin our paper by establishing the definition of strategic alliances and providing a brief overview of the literature on strategic alliances and alliance success in a supply chain context.

We describe in-depth the behavioural characteristics of strategic alliances as described by Mohr and Spekman (1994) and Monczka et al. (1998) as Alliance attributes, Communication behaviour and Alliance management. Based on these measures, we test the magnitude of each of the higher-order characteristics on operational performance improvements as perceived by managers. Finally, the implications of the study and avenues for further research are discussed.

## **3.2 Theoretical background and conceptual framework**

The domain of strategic alliances spans both contractual and equity arrangements. Since we believe that the way in which partners are brought together (i.e. contractually or equity arrangements) may influence the behaviour in the alliance, this study focuses only on strategic alliances based on non-traditional contractual arrangements. According to the definition of Yoshino and Rangan (1995), strategic alliances, which are different from simple buy-sell contractual arrangement, require the following necessary and sufficient conditions: (1) independence of the parties, (2) shared benefits among the parties and, (3) ongoing participation in one or more key strategic areas, such as technology, products, markets, etc. Another classification of supply chain alliances consists of four levels: traditional alliances, operational alliances, technological alliances and strategic alliances, with strategic alliances representing the most advanced form of alliance (En et al. 2007, Perona and Sacconi, 2004). In addition, we limit our definition of strategic alliances towards strategic alliances focusing on coordination of logistics, purchasing and/or operations activities. Consequently, we describe strategic alliances as “long-term cooperative relationships designed to increase the strategic operating capability of two individual firms, with the aim of achieving significant benefits to both parties. These alliances will last provided that they continue to offer significant value to each of the parties. Some of the main benefits of this type of relationships are the increase in the synchronization of the Supply Chain, the reduction of the total costs, the improvement of quality and cycle time, as well as a strong competitive position which exceeds any possible contribution from traditional relationships.” Using this definition as a basis for our study, we employ the measures for the behavioural characteristics as described by Mohr and Spekman (1994) and Monczka et al. (1998) to test the predictive value of these characteristics on the success of the alliance. Our hypotheses focus on three major behavioural characteristics of the alliance posited to be predictors of success: Attributes of the alliance, Communication behaviour and Alliance management.

Previous literature of Mohr and Spekman (1994) and Monczka et al. (1998) tested frameworks for alliance success. These frameworks are based upon two premises. First, alliances tend to exhibit behavioural characteristics that distinguish these more intimate alliances from more traditional (conventional) relationships. Second, while alliances tend to exhibit these behavioural characteristics, more successful alliances will exhibit these characteristics with more intensity than less successful alliances. This reasoning is supported by the resource-based view (RBV) and the relational view. The resource-based view argues that sustainable advantages result from resources controlled by a single firm (Barney 1991). However, the rapid growth of alliances across many firms has expanded this view by recognizing the importance of resources which lie outside of a firm's boundaries (Mathews 2003, Duschek 2004). According to this view, complementary resource combinations of firms working together can be a source of collaborative advantage. Our study is thus positioned within a framework of collaborative advantage (Dyer and Singh 1998), rather than one of competitive advantage. This collaborative advantage is a resource that requires a long-term orientation and may create greater benefits than a traditional zero-sum based approach to competition (Dyer 2000). Specifically, we rely on the relational view (Dyer and Singh 1998), an extension of RBV incorporating social network theory (Granovetter 1985, Burt 1992, Eisenhardt and Schoonhoven 1996). In summary, this view suggests that firms can obtain extra relational rents from strategic alliances.

Our research builds further on the framework developed by Mohr and Spekman (1994) and Monczka et al. (1998). While Mohr and Spekman (1994) included Alliance attributes, Communication behaviour and Conflict resolution techniques as behavioural characteristics in their framework, Monczka et al. (1998) also included the selection process as a behavioural characteristic. Furthermore, Mohr and Spekman (1994) developed behavioural characteristics associated with strategic alliances from a dealer's perspective (i.e. downstream), while Monczka et al. (1998) measured similar behavioural characteristics from the buyers perspective of strategic alliances. Since similar measurement scales and results were obtained for the two types of respondents, we did not make a distinction in our research between buyers and suppliers. We asked the respondent to fill in the survey on a strategic alliance in which they were involved. We believe that this approach enables the respondent, based on their experience, to fill in the questionnaire more accurately.

Next to the operations and the strategic management literature, also the marketing literature focuses on strategic alliances. The literature stream on relationship management (RM) (e.g. Johnson 1999, Palmatier et al. 2006, Palmatier 2008) shows for instance that RM is more effective when relationships are more critical i.e. are strategic in nature. Furthermore, this literature stresses to include multiple relational constructs. Research focusing only on limited relational constructs may provide misleading results. Previous research that offers either commitment or trust as the cornerstone relational construct may suggest that commitment or trust may be the aspect effecting performance. According to Palmatier et al. (2006), this view may be too narrow. A relationship may for instance be truly effective only when most or all of its key aspects are strong. Consequently, it is important in our research study to measure multiple characteristics of strategic alliances.

### **3.3 Hypotheses development**

#### **3.3.1 Behavioural characteristics of strategic alliances**

Strategic alliances require a proactive long-term view to relationship management, leading to closer, co-operative links with the key partners (Lawson et al. 2008, Chen et al. 2004). Behavioural characteristics can be described as the fundamentals to forge these strategic alliances. Based on a comprehensive literature study, we describe here the different behavioural characteristics of strategic alliances. Many studies focus on separate antecedents such as the relational attributes as trust or power (e.g. Ireland and Webb 2007), while others focus on information sharing (e.g. Zhou and Benton 2007) or on managing the alliance (e.g. Mentzer et al 2000). Only few empirical studies explore the formation of strategic alliances and include multiple antecedents (Mohr and Spekman 1994, Monczka et al. 1998). Based on the literature, we identified three antecedents of strategic alliances: Alliance attributes, Communication behaviour and Alliance management (Mohr and Spekman 1994, Monczka et al. 1998). In the next paragraphs, we describe these three behavioural characteristics in more detail.

##### **3.3.1.1 Alliance attributes**

A lot of attention has been given to Alliance attributes such as interdependence, trust, commitment and coordination (e.g. Johnston 2004, Ireland and Webb 2007). We describe each of these Alliance attributes in more detail.

Interdependence exists when one actor does not entirely control all the conditions necessary for achievement of an action or a desired outcome (Pfeffer 1988). Resource dependency theory provides the major organizational view regarding power and management in strategic alliances. According to this view, firms are seen as interdependent entities seeking to manage the uncertainty affecting them (Pfeffer 1988). These interdependencies create patterns of dependencies among the firms, a situation in which firms that own or control valuable, scarce resources hold power over firms seeking those resources to the extent that the dependency is not mutual. Firms lacking control over scarce resources can manage the resulting uncertainty through strategic alliances (Pfeffer and Salancik 1978). Previous empirical studies investigated the relationship between dependence, control and performance of inter-company relationships and found that a firm is less opportunistic when it depends on its partner (Provan and Skinner 1989) and that it can also positively influence other outcomes such as delivery performance (Handfield 1993).

Another Alliance attribute is trust. A large variety of dimensions of trust are described in the literature. Drawing on the literature in social psychology and marketing, trust can be defined as the perceived credibility and benevolence of the partner in the relationship (Geyskens et al. 1998). Based on this definition, trust can be measured by two dimensions. The first dimension focuses on the objective credibility of the partner in the alliance and the expectancy that the partner's word or written statement can be relied on. The second dimension, benevolence or goodwill, is the extent to which one partner is genuinely interested in the other partner's welfare and is motivated to seek joint gains (Johnston et al. 2008). As mentioned by Sako (1992) this second dimension, which is also called goodwill trust (Sako 1992), is particularly interesting in long-term buyer-supplier relationships and is responsible for creating a relational culture (Ireland and Webb 2007). Since our study focuses on strategic alliances, which are long-term in nature, we focus on the second dimension of trust: benevolence or goodwill trust. The important point here is that trust creates the feeling that the inter-firm relationship is beneficial for both parties. In addition, trust is considered to create a form of business harmony between two parties due to

interaction frequency. The main purpose of increasing trust is that it is found to enhance integration while lowering administrative costs.

Commitment, another Alliance attribute, is defined as an exchange partner believing that the alliance is so important as to warrant maximum efforts at maintaining it (Morgan and Hunt 1994). We can measure this by the willingness of partners to exert effort on behalf of the alliance, which may occur in the form of an organization's time, money, facilities, etc. These type of resources are often referred to as 'asset specific' resources, since they are directed specifically towards the other party (Monczka et al. 1998). Previous studies (e.g. Monczka et al. 1998) suggest that successful alliances result when both buyers and suppliers demonstrate a willingness to commit a variety of assets to a set of future transactions.

Finally, also coordination can be described as an Alliance attribute. *Coordination* reflects the set of tasks each party expects the other to perform and is directed at mutual objectives that are consistent across organizations (Anderson and Narus 1990). We can formulate our hypotheses as:

**Hypothesis 1:** *The degree of success of a strategic alliance in terms of Cost benefits is positively influenced by the level of Alliance attributes.*

**Hypothesis 2:** *The degree of success of a strategic alliance in terms of Service benefits is positively influenced by the level of Alliance attributes.*

### 3.3.1.2 Communication behaviour

Communication behaviour deals with the level of information sharing, the quality of this information and how this information is used and translated into the business processes of the partner.

Information sharing in the supply chain is about the sharing of knowledge among partners to serve downstream customers effectively and efficiently. This knowledge includes information on the production status and the planning process, but also on changes in the business environment and the goals of the companies. More specifically, information needs to be shared at different levels. While operational integration is geared towards transaction efficiency improvements, integration at the strategic level requires shared or matching objectives (Lamming et al. 2004). Information sharing is an important issue in supply chain management, particularly as a

component of supply chain practices that have recently become popular, such as Vendor Managed Inventories (VMI) and Collaborative Planning, Forecasting and Replenishment (CPFR). To guarantee the success of these supply chain management practices, it is essential that the better-informed downstream member of the alliance shares its demand information with the less-informed upstream member (Lee et al. 1997). Also upstream partners may share information with their downstream partners about for instance production plans and future deliveries. These information flows between alliance partners may lead to a better coordination of the stock levels and to logistic superiority in the strategic alliance (Freedman 1994).

Daft and Lengel (1986) found that the major problem in information processing is often not the lack of data, but clarity of the data. Furthermore, Petersen (1999) concluded that while much has been written about supply chain integration, little empirical research has been conducted to determine whether information quality helps to create better performing supply chains. The literature described Information quality as an important indicator of the clarity and usefulness of the information (Sum et al. 1995, McGowan 1998). It is measured by the degree (not the intensity) to which the information shared between supply chain partners meets the needs of the different partners (Petersen 1999). Researchers have identified different dimensions of Information quality. Neumann and Segev (1979), for instance, described high quality information as being accurate, frequently exchanged, recent and containing the appropriate content. Bailey and Pearson (1983) also described several dimensions of information quality as accurate, timely, precise, reliable, current and complete.

Finally, Information Participation or the extent to which partners engage jointly in planning and goal setting (Anderson et al. 1987) is essential to improve supply chain performance (Monczka et al. 1998). Companies sharing information with their partners should also be willing to openly discuss their practices and processes with partners (Mentzer 2000). When companies for example engage in joint R&D projects, partners need to understand each other's competencies and technology roadmaps, and need to share information on their latest developed technologies. Another example is a JIT system, where two partners need to have in-depth information on each other's production process and capabilities and use this information in the own planning system. As such, the information should not only be available, but should also be processed and translated into useful information for the partner. We formulate the following hypotheses:



**Hypothesis 3:** *The degree of success of a strategic alliance in terms of Cost benefits is positively influenced by its degree of Communication behaviour.*

**Hypothesis 4:** *The degree of success of a strategic alliance in terms of Service benefits is positively influenced by its degree of Communication behaviour.*

### **3.3.1.3 Alliance management**

Tan et al. (1998) examined the relationship between operational practices, supply chain management practices and firm performance. They concluded that supply chain management practices and tools must be implemented concurrently to achieve superior performance. Furthermore, Hsu et al. (2009) showed that supply chain management practices positively affect performance. The literature describes leadership capabilities and performance measurement systems as management related characteristics of strategic alliances (Mentzer 2000).

The ability of managers to lead supply chain projects is crucial for strategic alliances (Russell 2004). Without a champion moving the alliance forward, nothing significant will ever be accomplished (Mentzer 2000).

Second, supply chain projects require companies to share information on the performance related issues in order to measure and control the performance of the strategic alliance. The main purpose of measuring and controlling the performance of strategic alliances is to help companies understand their own supply chain situation and to set up a common understanding for supply chain management (Li and Dai 2009).

Consequently, our final two hypotheses are:

**Hypothesis 5:** *The degree of success of a strategic alliance in terms of Cost benefits is positively influenced by the degree of Alliance management.*

**Hypothesis 6:** *The degree of success of a strategic alliance in terms of Service benefits is positively influenced by the degree of Alliance management.*

### 3.3.2 Strategic alliance success

The challenge of supply chain managers is to identify and implement strategies that minimize cost while maximizing flexibility in an increasingly competitive and complex market (Wadhwa et al. 2008). Strategic alliances are thus expected to increase operational performance in two very distinct areas: cost reductions and service gains (Bowersox 2000, Mentzer 2000, Campbell and Sankaran 2005). This is in line with other research measuring operational performance (Frohlich and Westbrook 2001, Rozenzweig et al. 2003, Vereecke et al. 2006). Frohlich and Westbrook (2001) showed for instance that high levels of integration with both suppliers and customers lead to improvements in different areas of performance such as cost reductions and service gains.

Cost and flexibility are arguably two of the most distinct dimensions of operational performance (Ward et al. 1998, Safizadeh et al. 2000, Boyer and Lewis 2002). They are associated with different structural and infrastructural choices (Skinner 1974, Kotha and Orne 1989, Safizadeh et al. 2000).

According to the Transaction Cost Economics theory (TCE) (Coase 1937), strategic alliances should help companies to decrease the 'cost of running the system' by adapting and smoothing the supplier processes. Cost efficiency enables manufacturers to be more price-responsible and to subsequently gain higher margins than competitors due to lower manufacturing costs (Hill 1994). Carr and Pearson (1999) found that, over time, buying and selling firms were able to develop relationships that involved increased communication, cooperation, and coordination of all activities associated with the production of goods and services, which helped firms to reduce their costs.

Kotha and Orne (1989) find that integration can also help to develop flexible operations. Process flexibility is increasingly important in hypercompetitive environments, in which frequent changes in volume, product mix and schedules occur. Rosenzweig et al. (2003) contends that the development of process flexibility requires a great deal of closeness to supply chain entities. Consequently, process flexibility is believed to create higher customer satisfaction in the supply chain. Although a lot of studies focus on the link between strategic alliances and performance improvement, no research attempts to link the specific behavioural characteristics to the different types of performance improvements as presented in Figure 3.1.

## **3.4 Methodology**

### **3.4.1 Survey instrument and data collection**

Based on the literature review, a survey has been designed to measure the behavioural characteristics of strategic alliances. The survey asked for the behavioural characteristics of both the least and the most successful strategic alliance as perceived by managers. The unit of analysis is thus the strategic alliance established between a respondent company and one of its strategic alliance partners.

The targeted informants for the study were supply chain managers, logistics managers and purchasing managers from Belgian companies with more than fifty employees. The choice was made to focus on managers with appropriate supply chain knowledge and companies of sufficient size. The initial contact list of 300 companies was randomly developed from the CRM database of the sponsoring university for the study. The university has an extensive list of supply chain managers that have participated in executive education programs, thus we were able to select participants based on their function and company. An initial effort was made to contact participants to request whether they are engaged in strategic alliances with buyers and/or customers. This resulted in a sample of 200 companies. The extra effort devoted to making such an initial contact has been shown in prior studies to be an effective method of improving both response rate and reliability of the data (Zhao et al. 2008). The next step was to send the questionnaire to these 200 companies via e-mail. Following Dillman's (1978) total design method for survey data collection, follow-up phone calls have been made in order to maximize the response rate. The final results included 56 responses or 112 strategic alliances. As mentioned before, the survey asked the respondent to complete items with respect to strategic supplier or customer alliances, with the result that 34 surveys focused on customer alliances (downstream) and 78 focused on supplier alliances (upstream). This approach was used to allow respondents to clearly focus on supplier or customer integration, since we believe that most managers have no in-depth experience with both suppliers and customers. We believe this leads our respondents to give more accurate responses than when asked to simultaneously fill out a survey for both an upstream supplier and a downstream customer as in Frohlich and Westbrook

(2001). Furthermore, we believe that by reflecting on a specific alliance rather than general practices, respondents are more likely to report actual rather than projected or socially desirable practices (Choi et al. 1996).

Table 3.1 provides a demographic overview of the sample, which consists of companies in the primary goods, chemical, pharmaceutical, consumer goods, media and informatics industries. The largest groups in the sample are the chemical and consumer goods industry. This is representative of Belgian industry which possesses a large proportion of firms in these industries. The sample is biased towards larger companies (based on annual sales and number of employees), which is acceptable since the goal of the study is to focus on larger firms. In addition, the sample is biased toward supplier relationships with 68% of the respondents describing an upstream relationship. This may be a function of the job positions of the respondents, which are all supply chain focused, and thus more likely to look upstream than downstream.

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Insert Table 3.1 about here

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### **3.4.2 The measures**

The questionnaire items on Alliance attributes and Communication behaviour have been adopted from previous research by Mohr and Spekman (1994) and Monczka et al. (1998). We used 1 to 7 likert-scales (1= completely disagree, 7= completely agree) to measure these items. A confirmatory factor analysis on these existing scales showed good measurement properties. Except for the construct commitment, as described by Mohr and Spekman (1994) and Monczka (1998), no support was found in our measurement model (i.e. low factor loadings and high cross-loading). As such, we decided to drop the commitment construct from our study. The Alliance management items have been added based on the review of the recent literature as discussed above. Operational performance is measured by Cost and Service benefits. We asked the respondents to indicate to which degree the strategic alliance helped the firm to create cost and service benefits in the supply chain (1= very little, 7= very much). Cost benefits are measured as reductions in inventories, gains in efficiency in use of human resources and product and process

cost reductions. Service benefits are measured by improved customer service, delivery speed, speed to market of new products and increased flexibility. The draft of the questionnaire has been pre-tested on a sample of 10 experts (academics and people in the field), upon which some minor changes have been made.

As described in the literature, we define three types of antecedents: Alliance attributes, Communication behaviour and Alliance management techniques. A list with all items as found in the literature is in Appendix A. Since there were pre-existing scales for most of the constructs, we conducted Confirmatory Factor Analysis (CFA). Furthermore, we took great care to reach scale validity in three ways: content validity, construct validity and criterion-referenced validity (Thorndike 1996). For purpose of this study, content validity refers to the degree to which the scales properly reflect the antecedents of collaboration and measure the performance improvements of a specific relationship. Since our questionnaire is based on a comprehensive in-depth literature study on the behavioural characteristics of strategic alliances, content validity is accomplished. To guarantee construct validity several variables have been measured through multiple item measures. The reliability of these variables has been assessed by calculating the construct reliability. AVE (average variance extracted) has been used to reject or confirm the assumption that some theoretical constructs underlie the items (Carmines and Zeller 1979, DeVellis 1991, Fornell and Larcker 1981).

### **3.5 Statistical analysis and results**

We analyzed our data by using partial least squares (PLS), specifically PLS Graph version 3.0. PLS uses component-based estimation, maximizes the variance explained in the dependent variable, does not require multivariate normality of the data and accommodates both formative and reflective constructs (Chin 1998). It is particularly useful for smaller sample sizes, since it places minimal demands on measurement scales and distributional assumptions (Chin 1998, Wold 1982).

Multiple Imputation (Fishman and Cummings 2003) was used to replace missing values. Both Maximum likelihood estimation (ML) and multiple Imputation (MI) are known to be superior to ad hoc missing data techniques, such as listwise and pairwise deletion, with respect to both bias and efficiency (Enders 2001). One advantage of MI over maximum likelihood estimation is its

computational simplicity (Sinharay et al. 2001). The data analyses comprise three steps: (1) the creation of  $m$  imputed datasets, (2) the analysis of the  $m$  datasets and (3) pooling of the  $m$  sets of parameter estimates into a single set of estimates. Our data set has 4.5% missing observations and 13 missing patterns. To test for the applicability of MI, we used Little's MCAR tests ( $\chi^2 = 2476.55$ ,  $df=3237$ ,  $p=1.00$ ). The insignificant  $p$ -values confirmed that our data are missing completely at random (MCAR). We chose five imputations ( $m = 5$ ) to achieve 98 percent efficiency. Furthermore, according to the concept of superefficiency of Rubin (1996), we used all the questionnaire items for the imputation model.

In the next paragraph, we will first discuss the measurement model before analysing the structural model.

### **3.5.1 Measurement model**

For the measurement model, each construct was modelled to be reflective, with the exception of the dependent variables, which are modelled as formative. These formative items, in contrast to the reflective constructs, do not necessarily have to co-vary, are not interchangeable, and the direction of causality is from the items to the latent construct (Jarvis et al. 2003). Reflective constructs were validated using standard factorial validity for PLS as described by Gefen and Straub (2005), whereas formative constructs were validated following the recommendations of Diamantopoulos and Winklhofer (2001) and Petter et al. (2007).

For reflective constructs, the internal consistency and convergent validity were evaluated by examining the item-to-construct loadings, composite reliability, and average variance extracted (AVE). All item loadings were found to be higher than 0.60 and most of them even higher than 0.70. Furthermore,  $t$ -tests indicate that all items are significant at a 0.01 level. As shown in Table 3.2, the values of composite reliabilities are all higher than 0.805 (Nunnally and Bernstein 1994), and values of AVE are all above 0.511 (Fornell and Larcker 1981). Next, discriminant validity was assessed by examining if the squared correlation between a pair of latent variables was less than the AVE associated with each construct (Appendix B). Except for the AVE not being higher than the square of the Pearson correlation between Information sharing and Information participation, no problems with discriminant validity are reported. To further analyse discriminant validity, we calculated the item cross-loadings based on the procedure recommended for PLS (Gefen and Straub 2005). Each item loaded higher on its principal

construct than on other constructs (Appendix C). While cross-loadings derived from this procedure will be inevitably higher than from typical exploratory factor analysis (Gefen and Straub 2005), the cross-loading differences were much higher than the suggested threshold of 0.1 (Gefen and Straub 2005). Only the cross-loading between Information participation item b showed high correlation with the Information sharing construct (although, still lower than with its own construct). Since we want to keep the original constructs as much as possible and since this represents no important violation, we decided to keep the Information participation item as described in the literature. In summary, these results collectively suggest good measurement properties.

Formative constructs require a different approach for validation, since the assessment of convergent validity is not meaningful for these constructs (Chin 1998, Petter et al. 2007). To evaluate discriminant validity for formative constructs, we examined item-construct correlations and correlations with other constructs. All loadings and cross-loadings for the two formative constructs demonstrated an adequate level of discriminant validity. Overall, the measurement instruments exhibited sufficiently strong psychometric properties to support valid testing of the proposed measurement models.

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Insert Table 3.2 about here

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### **3.5.2 Common Method Bias**

Since our performance measures are self-reporting, we should test for Common Method Bias (CMB). First, we tried to minimize common method bias through the design of the survey. The survey instrument contains for instance questions in reverse order, used established scale items and reduced evaluation apprehension (Podsakoff et al. 2003). Furthermore, we carefully selected our respondents by first calling the respondent and asking some questions to create a sample of companies involved in strategic alliances. Finally, we asked questions about two specific strategic alliances that the respondent had to select, which should help to increase the correctness of the answers. After data collection, we performed the Harmon one-factor test recommended by Podsakoff and Organ (1986). A factor analysis combining independent and dependent variables

revealed no sign of a single-factor accounting for the majority of covariance. In addition, the correlations between the performance indicators and the relational antecedents were almost all significant and were between 0,075 and 0.709. Finally, results of the structural models demonstrated different levels of significance for path coefficients. The above evidence collectively suggests that common method bias is not a significant issue in this study.

### **3.5.3 Structural model**

With an adequate measurement model in place, the structural model was tested. A bootstrapping sample of 100 was used to estimate standard errors and to test the statistical significance of structural paths, since PLS does not provide t-tests. The resulting model explained a significant amount of variance in the dependent and the higher-order latent constructs. Figure 3.2 presents the final predictive model: it shows the standardized path coefficients.

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Insert Figure 3.2 about here

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The structural model shows support for our 3 higher-order constructs Alliance attributes, Communication behaviour and Alliance Management. As indicated by Figure 3.1, all first-order constructs had a significant effect on their higher-order construct. We thus showed the presence of three second-order behavioural characteristics: Alliance attributes, Communication behaviour and Alliance management. These characteristics were already described in the literature (Mohr and Spekman 1994, Monczka et al. 1998).

Based on these results, the analysis enabled us to evaluate the relative influence of the higher-order constructs on performance: i.e. the Alliance attributes, Communication behaviour and Alliance management on both Cost and Service Benefits. The results are provided in Table 3.3. These results particularly supported H1 and H2 specifying positive direct effects of Alliance attributes on both Cost and Service benefits. For the effect of Communication behaviour and Alliance management, we saw mixed results. While the variance of Communication behaviour explained a significant proportion of the variance explained by the Service benefits, no significant results were found for the Cost benefits. Consequently, H4 could be supported while



we could not support H3. The opposite is found for Alliance management. The variance explained by Alliance management is positively accounting for a significant variance of the Cost benefits, but not for the Service benefits. As such, our model predicts a positive effect of Alliance management on Cost benefits. In other words, H5 could be supported, whereas H6 could not be supported.

By looking at the relative variance of the different second-order latent constructs, we can state that the Alliance attributes account for most of the variance of the Alliance success. This is followed by the Communication behaviour and then finally the Alliance management variable explaining less of the variance in the Alliance success than the other two constructs.

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Insert Table 3.3 about here

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### **3.6 Discussion**

Previous research has indicated that integration practices, which are the main objective of a strategic alliance, are not always a guarantee for success (Frohlich and Westbrook 2001; Holweg et al. 2005, Vereecke and Muylle 2006). This seems to suggest that not the mere fact of adopting integration practices improves performance. Rather, some characteristics of the adoption of integration practices determine the performance of the alliance. Therefore, we looked at strategic alliances with high levels of integration practices. Within these alliances, our aim was to understand which other characteristics might influence the success of alliances. We focused on possible dimensions underlying the integration practices, referred to as behavioural characteristics, and studied to what extent these behavioural characteristics have an impact on the different operational performances such as cost and service.

Our results suggest that Alliance attributes, Communication behaviour and Alliance management, rather than the integration practices itself, predict the success of strategic alliances. Consequently, when these behavioural characteristics are present in larger proportions, the success of the strategic alliance is likely to be higher.

Our analyses also show that the Alliance attributes explain most of the variance in alliance success. This is followed by Communication behaviour. Alliance management, although still significant, explains least of the variance of the alliance success. These results suggest that building trust and coordination is the most important cornerstone for a successful alliance. Managers thus need to assure that the alliance is perceived to offer significant benefits to both partners and that they carefully plan their activities. Although communication behaviour and tools to help managing this alliance are also seen as significant contributors for alliance success, they are shown to be less crucial to the success of the alliance. Interestingly, our analysis showed that Communication behaviour was not significantly related to cost benefits. Yet, it is strongly related to service benefits. Information sharing and participation of high quality information helps companies to detect possible supply problems or changes in demand. This information can in other words help companies to react faster and to improve customer service or to create new products to adapt to the changing market. The analyses suggest the opposite effect for Alliance management on alliance success: only a significant effect on cost benefits is detected. These results indicate that leadership and performance measurement help supply chain partners to reduce costs, but do not directly contribute to creating an agile supply chain. Finally, Alliance attributes are believed to both improve service and decrease costs in the strategic alliance.

The importance of behavioural characteristics shows that managers should not underestimate the time and energy required to create and sustain a strategic alliance. Building up alliance attributes and managing the alliance are time intensive. Furthermore, our study shows that two different governance mechanisms are important for strategic alliances: formal (e.g. leadership and performance measurement) and informal mechanisms (e.g. trust and coordination) are complements rather than substitutes and should both be present to create successful strategic alliances.

Our study also shows that strategic alliances might create both cost and service benefits for the manufacturer. We thus empirically showed that the creation of strategic alliances generates relational rents for the firm (Dyer 2000). Consequently, strategic alliances in which behavioural characteristics such as trust, information participation and leadership are present, are shown to create value for the firm. Furthermore, these findings suggest that for buyers to achieve the full set of benefits of a strategic alliance, they must focus on all three behavioural characteristics. Previous research mainly focused on the Alliance attributes and on the communication streams

between partners, but not on the management of the alliances. This study shows the importance of structurally managing these alliances. As suggested by our analysis, alliance management enables the buyer to work in a cost efficient way. The results also show which choices companies can make in case of limited resources. While alliance attributes are the most important behavioural characteristics to invest in, the choice between communication behaviour and alliance management should be made based on the operational objectives one wants to accomplish (cost reductions or service improvements).

It is important to control for alternative explanations of our findings. We included the size of the manufacturing firm and the length of the strategic alliance as explicit controls in our model. No significant results of the effect of size and length of the alliance on our performance measures were obtained and hence we did not include them as control variables in the final model. Consequently, we could state that these two alternative explanations do not hold. This is also supported by other researchers. Stank (2001) found for instance that the best strategic alliances were remarkably similar regardless of industry, channel position or firm size. Similarly, Childerhouse and Tomwill (2002) reported that ‘exemplars’ in supply chain management shared a number of common and transferable best practices.

The theoretical development presented here also has interesting practical implication. Supply chain managers, purchasing managers, logistics managers and customer service managers can benefit from this research since it offers insights in the importance of different behavioural characteristics in strategic alliances. It also highlights which aspects of the relationship require attention, depending on the kind of benefits one wants to accomplish through the alliance. An evaluation of the framework could help managers to identify opportunities for establishing alliance practices with appropriate performance improvements.

### **3.7 Limitations and future research**

The findings from this research must be tempered by the limitations of the study. We tested our model for different types of companies, in different types of contexts. This increases the generalizability of our model, although it still raises some questions about possible contingencies such as for instance the supply chain strategy (Narasimhan et al. 2009). Future research should address and test these contingencies. In addition, data were collected from the manufacturer’s

side of the dyad. Consequently, the perception of the other party remains unknown. Collecting data on the perception of both partners in the supply chain is an avenue of future research. Another limitation of our research is the assumption of linearity. Recent research increasingly shows that there is a curvilinear relationship between for instance communication and performance (e.g., Patrashkova-Volzdoska et al. 2003, Hoegl and Wagner 2005). Since our aim was not to test the specific relationship between the characteristics and performance, we believe this assumption is valid. Future research, however, might focus on describing the shape of the relationship between the characteristics and performance. Although, our results are intuitively acceptable, an alternative explanation for our findings may be the presence of a time-lag in the interaction of these variables. Alliance management may for instance take a number of years to improve the service of the supply chain. Longitudinal studies may help to shed light on this issue.

Our research framework, based on rules of parsimony and based on our measurement model, mentioned two benefits: cost and service benefits. However, future research might have an explicit inclusion of an innovation aspect (which is now a part of the service construct). This would enable us to examine how much benefits are associated with ‘the delivery of the service’ versus ‘innovation’.

There are several research needs based on the results of the study. Future research based on case studies could provide here rich data and would be particularly valuable in substantiating the evolving nature of strategic alliances. Furthermore, the literature on strategic alliances should move towards processes and behavioural mechanisms that support working with partners to achieve benefits. This would help us to answer questions related to the management and the behavioural characteristics of the alliances. Furthermore, research has not yet systematically addressed the array of skills needed to help ensure that the partners’ goals are achieved. Consequently, effort must be dedicated to the formation of management strategies that encourage the continued growth and maintenance of the alliance.

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## Tables and Figures

Table 3.1: Demographic Characteristics of the respondents and respondent function

<b>Type of relationship:</b>	<b>Companies activity:</b>
- Customer: 18 (32%)	- Chemical: 26 (46%)
- Supplier: 38 (68%)	- Consumer goods: 11 (19%)
<b>Annual sales:</b>	- Primary industry: 8 (14%)
- < 25 million €: 2 (4%)	- Informatics and media: 7 (12%)
- 26-50 million €: 6 (11%)	- Pharmaceuticals: 4 (8%)
- 51-100 million €: 7 (12%)	<b>Position in the supply chain:</b>
- 101-500 million €: 18 (32%)	- Upstream: 13 (25%)
- > 500 million €: 23 (41%)	- Manufacturing: 34 (61%)
<b>Number of employees:</b>	- Downstream: 8 (14%)
- 51-250: 8 (15%)	<b>Length of the collaboration:</b>
- 251 -500: 18 (32%)	- Average: 8.61 years
- 501-1000: 9 (16%)	- Standard error: 7.64
- > 1000: 21 (37%)	
<b>Function of respondents:</b>	
- Supply chain Manager or Director: 30	
- Purchasing Manager or Director: 7	
- Logistics Manager or Director: 19	

**Table 3.2:** Factor loadings, construct reliability and AVE

	Factor Loading	Construct Reliability	AVE
Trust items		0.948	0.820
Trust_a	0.899		
Trust_b	0.923		
Trust_c	0.892		
Trust_d	0.907		
Coordination items		0.896	0.741
Coordination_a	0.855		
Coordination_b	0.912		
Coordination_c	0.812		
Interdependence items		0.857	0.603
Interdependence_a	0.604		
Interdependence_b	0.768		
Interdependence_c	0.887		
Interdependence_d	0.819		
Information sharing items		0.867	0.621
Information sharing_a	0.839		
Information sharing_b	0.849		
Information sharing_c	0.740		
Information sharing_d	0.716		
Information participation items		0.859	0.551
Information participation_a	0.782		
Information participation_b	0.749		
Information participation_c	0.718		
Information participation_d	0.775		
Information participation_e	0.681		
Information quality		0.955	0.811
Information quality_a	0.889		
Information quality_b	0.937		
Information quality_c	0.848		
Information quality_d	0.910		
Information quality_e	0.913		
Leadership items		0.913	0.778
Leadership_a	0.877		
Leadership_b	0.891		
Leadership_c	0.877		
Performance measurement items		0.805	0.582
Performance measurement_a	0.805		
Performance measurement_b	0.832		
Performance measurement_c	0.638		

**Table 3.3:** Hypothesis testing results

Path		
H1: Alliance attributes -> Cost benefits	0.353**	Supported
H2: Alliance attributes -> Service benefits	0.306**	Supported
H3: Communication behavior -> Cost benefits	0.163 N.S.	Not supported
H4: Communication behavior -> Service benefits	0.327**	Supported
H5: Alliance management -> Cost benefits	0.252**	Supported
H6: Alliance management -> Service benefits	0.116 N.S.	Not supported
Path coefficient is significant at ** p < 0.01, p < 0.05, N.S.: not significant (1-tailed)		

Figure 3.1: Predictive model of the behavioural characteristics

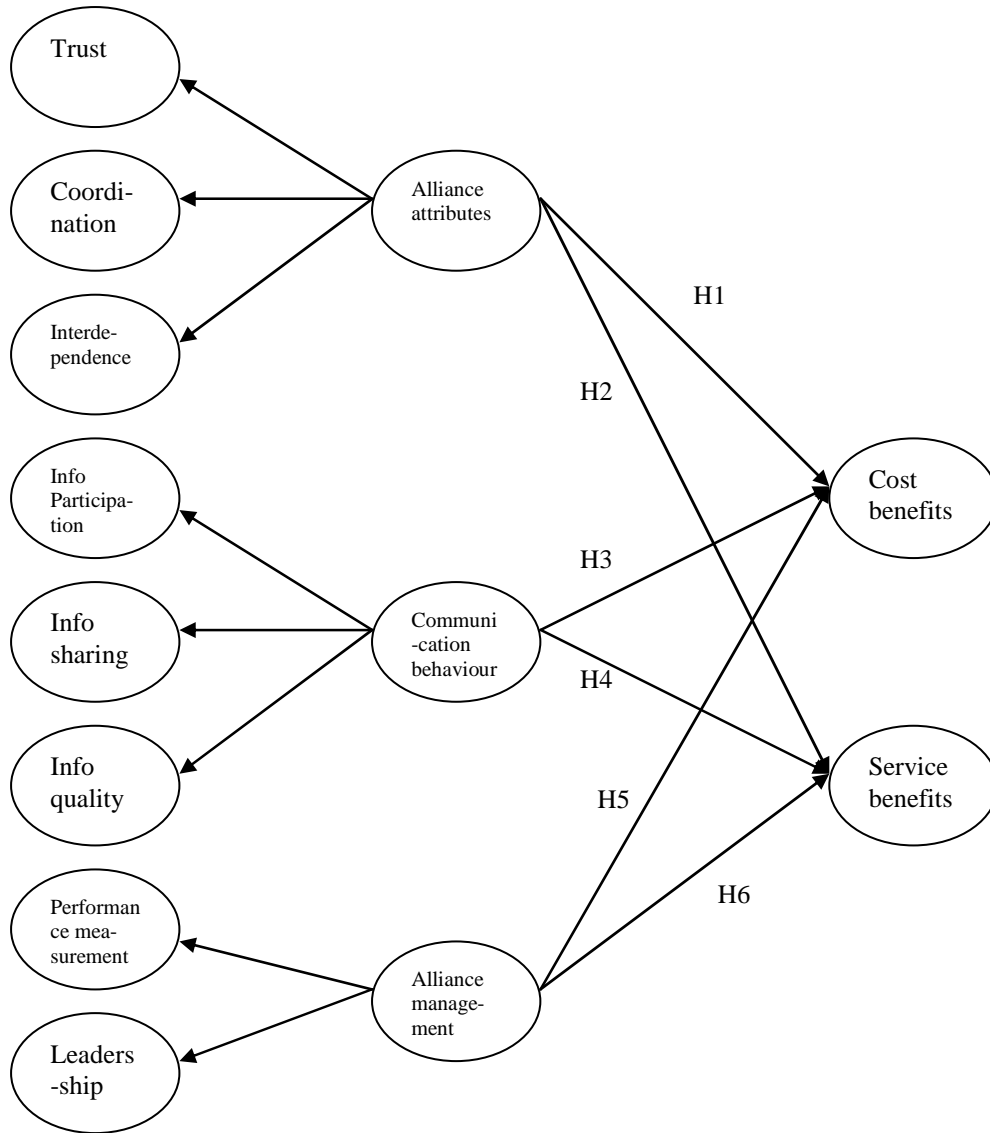
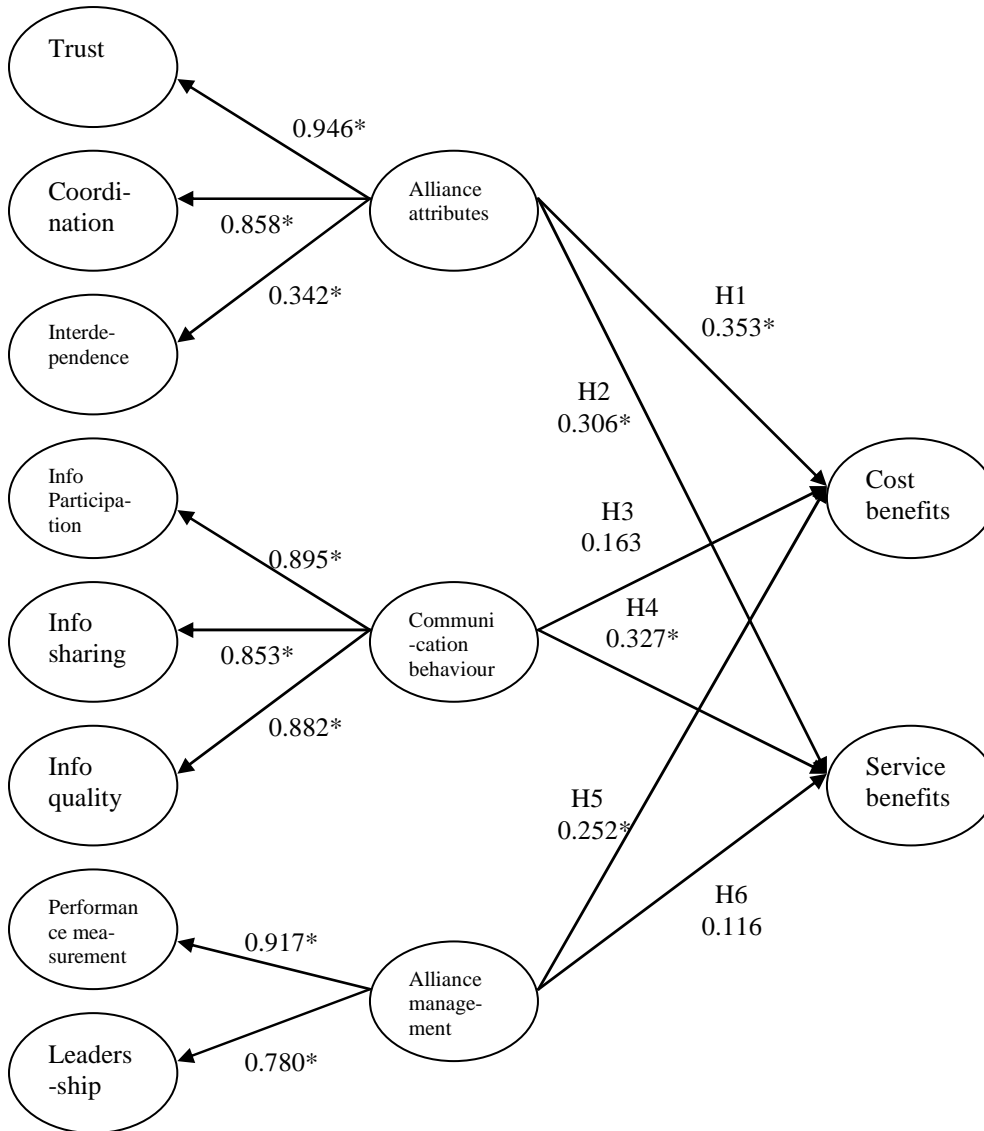


Figure 3.2: Structural model: Predictive model of the behavioural characteristics





# Appendices

## Appendix A: Behavioural characteristics items

Item	Statement
trust_a (Monczka et al, 1998)	The alliance is beneficial voor BU
trust_b	The alliance achieved a balanced agreement
trust_c	The alliance has a high level of business harmony
trust_d	The alliance offers significant benefits to both partners
interdependence_a (Monczka et al, 1998)	The alliance can easily be stopped without losses
interdependence_b	It is easy to end the alliance and start a new one
interdependence_c	Time to establish a new alliance will be extremely long
interdependence_d	Cost of establishing a new alliance would be high
coordination_a (Monczka et al, 1998)	Each party knows his role
coordination_b	Collaborative practices are planned carefully
coordination_c	The degree of coordination in the alliance is high
info_participation_a (Monczka et al, 1998)	Actively seeking for advice, guidelines and info from partner
info_participation_b	Partner takes part in planning activities and setting aims and goals
info_participation_c	We take part in planning activities, aims and goals of partner
info_participation_d	Actively seeking for proposals or suggestions for improvement from partner
info_participation_e	We react appropriately to partner's suggestions
info_sharing_a (Monczka et al, 1998)	We share confidential info about BU with partner
info_sharing_b	Partner shares info about his BU
info_sharing_c	We inform the partner in advance of changes in needs
info_sharing_d	Both parties share all useful info
communication_quality_a (Huber et al, 1987)	Communication is on time
communication_quality_b	Communication is exact
communication_quality_c	Communication is appropriate
communication_quality_d	Communication is complete
communication_quality_e	Communication is reliable
Performance_measurement_a (based on McCarter, 2005)	We have an ABC-system that provides info on activities across SC
Performance_b	we use a target costing process, extended into partners
Performance_c	Both parties work with open books
Leadership_a (based on McCarter, 2005)	There is a strong leader in both companies to lead SC changes
Leadership_b	There is common understanding of the degree of change that is needed
Leadership_c	There is a strong drive throughout the organization to make the integration work
Cost_benefit_a	reduce the inventory
Cost_benefit_b	reduce process costs
Cost_benefit_c	reduce process costs
Cost_benefit_d	Use your human resources more efficient
Service_benefit_a	Improve customer service
Service_benefit_b	Increase delivery speed
Service_benefit_c	Increase speed to market for new products
Service_benefit_d	Increase flexibility

We used 7-point likert scales with 1= strongly disagree and 7= strongly agree for the behavioral characteristics

We asked the following question for supply chain performance:

Specify to which degree the strategic alliance help you to enable you to: (1= very little, 7= very much)

## Appendix B: Squared pairwise correlations and assessment of discriminant validity

	Trust	Coord	Interd	InfPar	InfShar	InfQual	Leader	Perf	CosBen	SerBen
Trust	<b>.820</b>									
Coord	.464	<b>.741</b>								
Interd	.024	.050	<b>.603</b>							
InfPart	.334	.304	.051	<b>.551</b>						
InfShar	.304	.324	.100	.605	<b>.621</b>					
InfQual	.371	.287	.066	.406	.329	<b>.811</b>				
Leader	.557	.500	.036	.441	.505	.446	<b>.778</b>			
Perf	.184	.191	.072	.262	.206	.099	.216	<b>.582</b>		
CosBen	.503	.238	.006	.308	.265	.282	.354	.421	N/A	
SerBen	.421	.203	.030	.334	.238	.345	.354	.360	.529	N/A

AVE of the reflective constructs are presented on the diagonal.

Squared correlations are presented off the diagonal.

## Appendix C: Item-factor loadings and cross-loadings

	TRUST	COORD	INTERD	INFPAR	INFSHAR	INFQUAL	LEADER	PERF	COSBEN	SERBEN
trust_a	<b>.899</b>	.544	.134	.466	.435	.511	.642	.390	.659	.593
trust_b	<b>.925</b>	.670	.110	.517	.534	.539	.705	.427	.642	.563
trust_c	<b>.894</b>	.626	.235	.539	.512	.639	.683	.308	.649	.656
trust_d	<b>.910</b>	.625	.083	.569	.513	.518	.670	.427	.620	.543
coord_a	.536	<b>.859</b>	.041	.444	.491	.314	.548	.343	.370	.264
coord_b	.646	<b>.915</b>	.164	.479	.486	.531	.659	.372	.448	.374
coord_c	.583	<b>.812</b>	.360	.504	.499	.520	.615	.415	.440	.520
inter_invert_a	(.55)	.021	<b>.604</b>	.065	.152	.037	.021	.023	(.131)	(.058)
inter_bi	.126	.192	<b>.745</b>	.151	.221	.210	.182	.174	.103	.195
inter_c	.111	.161	<b>.887</b>	.150	.226	.179	.131	.183	.0113	.119
inter_d	.148	.222	<b>.819</b>	.244	.327	.258	.173	.304	.110	.146
info_particip_a	.444	.395	.150	<b>.784</b>	.557	.459	.452	.342	.369	.370
info_particip_b	.425	.458	.348	<b>.749</b>	.685	.504	.614	.370	.423	.508
info_particip_c	.522	.346	.250	<b>.715</b>	.530	.461	.410	.453	.474	.489
info_particip_d	.392	.388	(.010)	<b>.777</b>	.604	.475	.535	.365	.403	.420
info_particip_e	.365	.460	.094	<b>.683</b>	.498	.459	.438	.378	.394	.346
info_sharing_a	.376	.355	.289	.620	<b>.839</b>	.512	.563	.247	.383	.411
info_sharing_b	.564	.532	.235	.664	<b>.849</b>	.584	.707	.351	.514	.517
info_sharing_c	.327	.437	.233	.528	<b>.740</b>	.312	.464	.453	.313	.294
info_sharing_d	.448	.476	.240	.634	<b>.716</b>	.357	.473	.418	.390	.280
commu_a	.541	.478	.161	.604	.520	<b>.889</b>	.614	.311	.547	.557
commu_b	.568	.478	.268	.532	.556	<b>.937</b>	.636	.235	.505	.578
commu_c	.536	.498	.184	.528	.494	<b>.849</b>	.580	.266	.382	.414
commu_d	.524	.507	.272	.599	.503	<b>.910</b>	.586	.337	.462	.472
commu_e	.574	.454	.267	.601	.511	<b>.913</b>	.592	.266	.488	.615
leadership_b	.675	.616	.165	.530	.633	.592	<b>.878</b>	.433	.487	.513
leadership_c	.607	.650	.150	.602	.647	.577	<b>.891</b>	.360	.481	.476
leadership_d	.691	.609	.186	.630	.605	.601	<b>.878</b>	.442	.606	.584
performance_ev4	.327	.288	.073	.364	.284	.216	.334	<b>.805</b>	.380	.346
performance_ev4	.273	.370	.270	.329	.271	.170	.264	<b>.834</b>	.310	.181
performance_ev4	.360	.337	.276	.459	.466	.313	.444	<b>.636</b>	.435	.356
COSBEN*	.709	.488	.075	.555	.515	.531	.595	.500	<b>1</b>	.727
SERBEN*	.649	.451	.173	.578	.488	.587	.595	.394	.727	<b>1</b>

PLS item cross-loadings were calculated according to the procedure suggested by Gefen and Straub (2005). While the cross-loadings for some of the constructs are relatively high, the differences between loadings on principal factors and on other constructs are higher than the threshold suggested by Gefen and Straub (i.e. difference of 0.1). Only the item info\_participation\_b indicated a smaller difference than 0.1 with the info\_sharing construct.

\*COSPER and SERPER are both formative construct, whose index score is computed as a unit mean their items. numbers between () are present negative values.

# Chapter 4: Supply chain information flow strategies: An empirical taxonomy

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This paper identifies different information flow strategies to enhance integration in strategic alliances and studies these strategies with respect to contextual factors and the impact on performance. Based on a parsimonious description of inter-firm information flows in the literature and our empirical findings, we identify 3 types of alliances: Silent, Communicative and IT intensive alliances. While Silent alliances have the poorest overall performance, substantial similarities are found between Communicative and IT intensive alliances. In particular, the analysis suggests that IT intensive alliances, albeit performing better on operational capabilities, are not performing better on relationship satisfaction compared to Communicative alliances. Additional analyses indicate that partners of an IT intensive alliance are substantially more interdependent and larger in size.

Keywords: Integration, Information flow, IT supply chain applications, Strategic alliances

This chapter is a paper forthcoming in the International Journal of Operations and Production Management.

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## 4.1 Introduction

Information sharing and collaboration with trading partners is seen as a company's top logistic challenge according to a poll of Supply & Demand Chain Executive's readers (Supply & Demand Chain Executive 2005). This is confirmed by academic researchers who identify inter-firm information flows as an important factor of supply chain management (Chen and Paulraj 2005, Carr and Kaynak 2007). An important reason for this growing attention towards inter-firm information flows is the increasing amount of externalized activities (Cagliano, Caniato and Spina 2005).

While the literature describes different mechanisms for integrating supply chains, such as information sharing (Lee, Padmanabhan and Whang 1997, Vereecke and Muylle 2006) and structural coordination (Vereecke et al. 2006), the focus of this paper is on the information flow, which forms the foundation for some advanced mechanisms of integration (Zhou and Benton

2007). There has been an extensive literature stream on the value of information sharing in general. Recently, this topic has received increased attention in the specific context of inter-firm relationships. For example, Lee and Whang (2000) provide some real life illustrations of information sharing in a supply chain. There is also an extensive amount of literature on theoretical models quantifying and analyzing the effect of information sharing between partners in the supply chain (Chen 1998, Gavirneni, Kapuscinski and Tayur 1999, Chen, Drezner, Ryan and Simchi-Levi 2000). All of these papers report some benefits to sharing information. These potential benefits of information sharing include supply chain coordination, a bullwhip effect reduction and decreased supply chain costs (Lee et al. 1997). However, the reported benefits vary substantially across specific numerical examples in the Operations Research literature: some studies show substantial value (e.g. Gavirneni et al. 1999; Lee et al. 2000) while others show negligible value of information sharing in supply chains (e.g. Cachon and Fisher 2000, Raghunathan 2001). While valuable, much of the cited work is stylistic in the sense that it is modeling theoretical supply chains<sup>1</sup>. Therefore, our aim is to assess actual supply chain practices.

Existing theory on information sharing in purchasing relationships has emerged from survey data explaining how frequently buyers and suppliers exchange information and what media are used to exchange this information (Carr and Kaynak 2007). However, these studies do not distinguish between different contexts in which these relationships are formed. While there is general support for the relationship between information sharing, supply chain integration and performance improvement, there is quite a bit of uncertainty regarding the contingent nature of such relationships. The work of Ketzenberg, Rosenzweig, Maruccheck and Metters (2007) demonstrated that although technology has made the sharing of information easier, managers should not assume that more information automatically implies better performance. Therefore, they argue that future research should focus on the environment, coupled with the specific use of information, to determine the value of information sharing. Furthermore, most studies only look at the extent to which information is shared between partners, without looking at the quality of this information and the systems used to share this information. In this study, we will include

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<sup>1</sup> An overview of some important work in this literature on building alliances through economic incentives can be found in Appendix C.

these multiple elements in order to examine information flow as opposed to the more unidimensional assessment of information sharing in prior research. In summary, the focus of the current work is to better understand the supply chain environment and the effects of contingencies on the information flow strategy.

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Insert Figure 4.1 about here

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Figure 4.1 provides a model of the relationships tested in this paper. We start our analysis by looking at the foundations of supply chain integration, which we define as the information flow between partners. This is discussed in the next paragraph. Based on this classification, we empirically develop a taxonomy of supply chain information flow strategies. Next, we examine the choice of the information flow strategy. Finally, we examine performance factors which are believed to be improved by higher levels of information flows and thus influenced by the choice of the information flow strategy. These analyses will help us to better understand the impact of contingency factors on the link between supply chain integration and performance improvement.

## **4.2 Literature review**

### **4.2.1 Information flow strategies**

Supply chain management takes a systems view regarding all processes needed to bring a product to the final customer. This view recognizes that the value creation process extends beyond the boundaries of the firm, and involves integrated business processes among the entities of the chain, such as suppliers, manufacturers, and customers (Porter 1985). This requires the supply chain to be ultimately managed as one complete system (e.g. Currie 2000) and asks for integration practices that strengthen linkages across individual firm functions as well as throughout the supply chain (Vickery, Jayaram, Dröge and Calantone 2003). Although, the literature posits that integration throughout the supply chain is highly beneficial, there is insufficient empirical evidence to support this ‘one-size-fits all’ assertion. Moreover, Harland, Caldwell, Powell and Zheng (2007) found that firms are not concerned with the integration of information in their supply chains. This strengthens the belief that integration might only be

appropriate in certain types of supply chains or within certain parts of supply chains. We thus suggest a more complex, contingent approach to information integration in supply chains.

The domain of inter-organisational linkages in a supply chain spans both contractual and equity arrangements. Since we believe that the way in which partners are brought together (i.e. contractually or through equity arrangements) may influence information flows, this study focuses only on strategic alliances based on nontraditional contractual arrangements. Based on the definition of Yoshino and Rangan (1995), strategic alliances, which are different from simple buy-sell contractual arrangements, require the following necessary and sufficient conditions: (1) independence of the parties, (2) shared benefits among the parties and, (3) ongoing participation in one or more key strategic areas, such as technology, products, markets, etc. In addition, we limit our definition of strategic alliances towards strategic alliances focusing on coordination of logistics, purchasing and/or operations activities. Consequently, we describe strategic alliances as “long-term cooperative relationships designed to increase the strategic operating capability of two individual firms, with the aim of achieving significant benefits to both parties. These alliances will last provided that they continue to offer significant value to each of the parties. Some of the main benefits of this type of relationships are the increase in the synchronization of the supply chain, the reduction of the total costs, improvement of quality and cycle time, as well as a strong competitive position which exceeds any possible contribution from traditional relationships (Monczka et al. 1998).”

Similar to Zhou and Benton (2007), we describe the information flow as the foundation for integration in the strategic alliance. Based on their definition, we describe this information flow by three characteristics: *level of Information sharing*, *Information quality* and *IT supply chain applications*. These characteristics provide a parsimonious description of three logical dimensions of the information flow, i.e. the volume, the content and the medium of the shared information.

In the following sections, we describe these information flow characteristics as defined by Zhou et al. (2007). Next, we provide insights into testable propositions regarding the use of information flows in a supply chain context.

#### **4.2.1.1 Information sharing**

Information sharing in the supply chain is the sharing of knowledge among partners to serve downstream customers effectively and efficiently. This knowledge includes information on the production status and the planning process, but also on changes in the business environment and the goals of the companies. More specifically, information needs to be shared at different levels. While operational integration is geared towards transaction efficiency improvements, integration at the strategic level requires shared or matching objectives (Lamming, Caldwell and Harrison, 2004). Information sharing is an important issue in supply chain management, particularly as a component of supply chain practices that have recently become popular, such as Vendor Managed Inventories (VMI) and Collaborative Planning, Forecasting and Replenishment (CPFR). To guarantee the success of these supply chain management practices, it is essential that the better-informed downstream member of the alliance shares its demand information with the less-informed upstream member (Lee et al. 1997). Also upstream partners may share information with their downstream partners about for instance production plans and future deliveries. These information flows between alliance partners may lead to a better coordination of the stock levels and to logistic superiority in the strategic alliance (Freedman 1994).

#### **4.2.1.2 Information quality**

Daft and Lengel (1986) found that the major problem in information processing in organizations is not the lack of data, but the lack of clarity of the data. Furthermore, Petersen (1999) concludes that while much has been written about supply chain integration, little empirical research has been conducted to determine whether information quality helps to create better performing supply chains. The literature describes Information quality as an important indicator of the clarity and usefulness of the information (Sum, Yang and Quek 1995, McGowan 1998). It is measured by the degree to which the information shared between supply chain partners meets the needs of the different partners (Petersen 1999). Researchers have identified important dimensions of Information quality. Neumann and Segev (1979), for instance, described high quality information as being accurate, frequently exchanged, recent and containing the appropriate content. Bailey and Pearson (1983) also described several dimensions of information quality as accuracy, timeliness, precision, reliability, currentness and completeness.

#### **4.2.1.3 IT supply chain applications**

Information technology (IT) plays a critical role in supply chain management activities (Kearns and Lederer 2003), as it permits the sharing of large amounts of information between firms. More specifically, a high degree of system integration between two firms allows two proprietary systems to reduce technical barriers and incompatibility so as to communicate more effectively (Bowersox, Closs, Stank and Keller 2000). The use of IT systems in inter-firm integration is supported by transaction costs economics, which generally posits that IT reduces transaction costs. (Coase 1937, Williamson 1996). However, in practice, new IT may result in higher transaction costs, caused by the higher cost of processing the information costs. If these coordination costs exceed the benefits of IT, the implementation of IT becomes expensive (Cordella 2006).

Past empirical studies have evaluated the link between IT supply chain applications and integration. Earlier studies focused on the benefits of EDI and showed that it provides benefits to companies by providing speed of information flow and fostering value-added partnerships between supply chain organizations (Holland, Lockett and Blackman 1992; Ragatz, Handfield and Scannell 1997). A study by Stoeken (2000) showed that IT has a direct impact on coordination and leads to supply chain innovation. Furthermore, Shaw (2000) shows that emerging manufacturing technologies have an influence on supply chain activities and supply chain structures and that emerging web-based manufacturing technologies make information transmission among the supply chain partners easier. Jagdev and Thoben (2001) also indicate that standardized systems embedded in the processes result in buyer-supplier dyads going beyond passive information exchange by engaging in proactive collaboration. Vickery et al (2003) further showed a direct link between integrative information technologies and supply chain coordination for supplier firms in the car industry. Finally, a recent study by Johnson, Klassen, Leenders and Awaysheh (2007) confirmed the relationship between IT supply chain applications and decreasing transaction costs. In summary, all these studies point to a positive link between the IT supply chain applications and performance.

The literature describes different information sharing methods. While traditional information sharing methods involve the use of telephone, fax, e-mail, written and face-to-face contact, advanced information sharing methods refer to computer-to-computer links, electronic data



interchange (EDI) and enterprise resource planning (ERP) (Carr and Kaynak 2007). Sanders (2007) points out that inter-firm integration requires shared planning, coordination and sharing of integrated databases between firms. She categorized information sharing support systems as supply chain planning systems, information exchange systems and database collaboration systems. These technologies are supply chain ‘enablers’, in that they can substantially reduce paperwork, improve communication and reduce supply chain cycle times if properly implemented. A primary requirement for efficient information flow integration is that the relationship is characterized by a willingness to share and receive information and work in a collaborative manner (Handfield and Bechtel 2002).

#### **4.2.1.4 Information flow strategies**

As described above, a relevant classification dimension is based on the information flow characteristics: information sharing, information quality and IT supply chain applications. These characteristics provide a parsimonious description of the information flow. Drawing on the discussion offered in sections 4.2.1.1 – 4.2.1.3, we develop the following proposition:

**Proposition 1:** *Different information flow strategies can be identified according to the level of information sharing, the information quality and the IT supply chain applications used.*

Proposition 1 is evaluated by using cluster analysis to form an empirical classification of strategic alliances based on the information flow strategy. This classification is then used to test our propositions related to context and performance. The propositions are presented in the following paragraphs.

#### **4.2.2 Contextual and performance factors of supply chain information flow strategies**

The process of validating our clustering requires that we assess it in the context of its nomological network, i.e. other related constructs (Shwab 1980). More specifically, we will look at the contextual factors and the performance of our clusters. Business and relational characteristics are identified as environmental factors impacting the effectiveness and performance of the strategic alliances.

#### **4.2.2.1 Contextual factors affecting the information flow strategy**

In this paragraph, we describe the contextual factors that are posited to affect the information flow characteristics. Two contextual factors are presented to describe the context of the relationship: business and relationship characteristics. Business characteristics consist of the size of the responding company and the supply chain dynamics of the alliance. The relationship specific characteristics are measured by the degree of trust and interdependence in the strategic alliance. We describe these contingencies more in depth in the following paragraphs.

##### ***4.2.2.1.1 Business characteristics***

The size of the firms in the strategic alliance has been highlighted as a driver of differences in information flow characteristics (Harland et al. 2007). It is often argued that larger firms have more resources to invest in information sharing, and therefore it is easier for larger firms to invest in technologies for information sharing than for relatively small firms. Furthermore, larger companies can exert more power in strategic alliances, which may lead to higher levels of performance improvement of inter-company integration (Benton and Maloni 2005, Subramani and Venkatraman 2003, Lee 2004). Mehrthens, Gragg and Mills (2001) suggest three main factors that influence a companies' decisions about IT supply chain application investments: the perceived benefits, the organizational readiness and the external pressures. Small companies score generally lower on all three characteristics, indicating that they invest less in IT supply chain applications. Salmeron and Bueno (2006) and Harland et al. (2007) highlighted that smaller firms are often less aware of the full potential benefits of IT supply chain applications. Beyond the lack of awareness, small firms have been shown to exhibit a greater uncertainty of the benefits of IT adoption than larger firms (Salmeron et al. 2006), thus impacting their motivation to invest in IT supply chain applications. Based on these studies, we could state that small companies invest less in IT supply chain applications compared to large companies. Consequently, smaller firms use relatively less advanced information flow strategies compared to larger firms.

A second business characteristic is the business context of the alliance. Information processing theory supports the influence of supply chain dynamics on the information flow (Galbraith, 1974, Zhou et al. 2007). Supply chain dynamics is defined in the literature as the unpredictable

changes in products, technologies and demand for products in the market (Miller and Friesen, 1983, Zhou et al. 2007). As supply chain dynamics increases, information processing capacity needs to be increased in order to achieve superior firm performance. Fisher (1997) for instance suggests that supply chains facing a different level of supply chain dynamics should use different supply chain practices. Based on these theories, we can state that product (e.g. volatile versus stable demand) and market (e.g. level of competitiveness, foreign competition) characteristics, influence the information flows between partners in the supply chain. Ketzenberg et al. (2007) also state that information sharing is more valuable in supply chains with high uncertainty. In summary, we state that more supply chain dynamics leads to higher levels of information flows.

#### ***4.2.2.1.2 Relational characteristics***

Two relation-specific characteristics receive a great deal of attention in the literature on strategic alliances. The first relational characteristic, interdependence, exists when one actor does not entirely control all the conditions necessary for achievement of an action or a desired outcome (Pfeffer 1988). Resource dependency theory provides the major organizational view regarding power and management in strategic alliances. According to this view, firms are seen as interdependent entities seeking to manage uncertainty affecting them (Pfeffer 1988). These interdependencies create patterns of dependencies among the firms, a situation in which firms that own or control valuable, scarce resources hold power over firms seeking those resources to the extent that the dependency is not mutual. Firms lacking control of scarce resources can manage the resulting uncertainty through strategic alliances (Pfeffer and Salancik 1978). Previous empirical studies investigated the relationship between dependence, control and performance of inter-company relationships and found that a firm is less opportunistic when it depends on its partner (Provan and Skinner 1989) and that it can also influence other outcomes such as delivery performance (Handfield 1993).

The second relational characteristic is trust. A large variety of dimensions of trust exist in the literature. Drawing on the literature in social psychology and marketing, trust can be defined as the perceived credibility and benevolence of the partner in the relationship (Geyskens, Steenkamp and Kumar 1998). Based on this definition, trust can be described by two dimensions. The first dimension focuses on the objective credibility of the partner in the buyer-

supplier relationship and the expectancy that the partner's word or written statement can be relied on. The second dimension, benevolence or goodwill, is the extent to which one partner is genuinely interested in the other partner's welfare and is motivated to seek joint gains (Johnston et al. 2008). As mentioned by Sako (1992) this second dimension, which is also called goodwill trust (Sako 1992), is particularly interesting in long-term buyer-supplier relationships and is responsible for creating a relational culture (Ireland and Webb 2007). Since our study focuses on strategic alliances, which are long-term in nature, we focus on the second dimension of trust: benevolence or goodwill trust. The important point here is that trust creates the feeling that the inter-firm relationship is beneficial for both parties. In addition, trust is considered to create a form of business harmony between two parties due to interaction frequency. The main purpose of increasing trust is that it is found to enhance integration while lowering administrative costs. Some researchers suggest that greater levels of asset specificity, which create interdependence among the partners, increase trust in the alliance (Handfield et al. 2002).

**Proposition 2:** *The information flow strategy selected by the strategic alliance is influenced by contextual factors such as business characteristics and relational characteristics.*

#### **4.2.2.2 Performance of the alliance**

The potential benefits of inter-firm information flows include improved supply chain integration and decreased supply chain costs by reducing uncertainties caused by both the bullwhip effect (Anand and Mendelson 1997, Lee et al. 1997) and by differences in the timing of demand and arrival of supply (Kouvelis and Li 2008). We use two indicators of successful integration: the use of advanced integrative forms and performance benefits.

##### **4.2.2.2.1 Advanced forms of supply chain integration**

Zhou and Benton (2007) confirmed that supply chain information sharing enhanced effective supply chain practices. Consequently, we included a measure of effective supply chain practices in our research (or what we call: advanced forms of supply chain integration). Ketzenberg et al. (2007) describe that the responsiveness and the use of the information flow moderate the value of the information flows. Increased responsiveness and use of this information can be obtained by more advanced forms of supply chain integration. Examples of these advanced forms of

integration are Information participation, Coordination and Conflict resolution (Monczka, Petersen, Handfield and Ragatz 1998). Information participation refers to the extent to which partners engage jointly in planning and goal setting (Mohr and Spekman 1994). Supply chain partners must first commit to providing better and more accurate information and forecasts in order to allow them to plan their available capacity more effectively. Coordination, another advanced form of integration, reflects the set of tasks each party expects the other to perform (Monczka et al. 1998). Coordination reduces the transaction costs since it makes clear which tasks need to be done in the alliance and who will perform the specific tasks. Both Information participation and Coordination describe integration under typical circumstances. However, conflicts often arise with partners and require techniques to resolve problems. The way companies handle these conflicts has a substantial impact on the success of the integration. Research has shown that the use of constructive conflict resolution techniques, where both companies jointly eliminate the conflict, has a positive impact on the strategic alliance (Deutsch 1986). The way in which these conflicts are resolved among the alliance partners has direct implications for the success and continuity of the relationship. Since information flows form the foundation for more advanced forms of supply chain integration, we could state that more advanced information flow strategies will be associated with more advanced forms of supply chain integration.

#### ***4.2.2.2 Performance benefits***

While past studies primarily focus on financial performance measures, our study measures a more comprehensive set of benefits for the company, called first-order or operational capabilities. First-order benefits are posited to generate second-order benefits for the firm, which occur over the long run and include measures such as improved financial performance and market share (Mukhopadyay and Kerke 2002, Subramani 2004). Since this study looks at a broad set of first-order benefits and Relationship satisfaction, it provides a more comprehensive evaluation of performance.

We measure the first-order benefits by the four operational capabilities: quality, cost, flexibility and delivery. Hayes and Wheelwright (1984) originally presented these capabilities as the dimensions on which a company chooses to compete within a market. There is general

agreement in the operations strategy literature that these four capabilities are indeed the core areas from which a company chooses to compete (Roth and Miller 1992, White 1996). In addition, innovation has recently been recognized as another dimension upon which companies can compete (Ward et al. 1998). These capabilities have been used in the literature to measure both process abilities and operational performance. We measure here the operational performance and expect that higher levels of information flows will lead to better performance.

Relationship satisfaction is based on the notion that success is determined by how well the relationship achieves the performance expectations set by the alliance partners (Anderson and Narus 1990, Mohr and Spekman 1994).

**Proposition 3:** *The information flow strategy selected by the strategic alliance influences the performance of the alliance in terms of the use of advanced integration practices, the operational performance and relationship satisfaction.*

## **4.3 Methodology**

### **4.3.1 Data collection**

The sample consists of manufacturing companies in Belgium. Data were collected during the second half of 2006 and beginning of 2007. The unit of analysis is a strategic alliance of a principal company with a supplier or customer. We asked the respondents to describe a most successful and a least successful strategic alliance. This is different from most other research focusing only on successful alliances (e.g. Johnston and Kristal 2008).

The targeted informants for the study were supply chain managers, logistics managers and purchasing managers from companies with more than fifty employees. This choice was made to focus on managers with appropriate supply chain knowledge and companies of sufficient size to be likely to employ supply chain information flow strategies. An initial contact list of 300 manufacturing companies was randomly developed from the Customer Relationship Management database of the sponsoring university. This database consists of an extensive list of supply chain managers who participated in executive education programs. We were thus able to select participants based on their function and company. An initial effort was made to contact participants to request their participation in the study, with the result that 200 managers agreed.

The extra effort devoted to making such an initial contact has been shown in prior studies to be an effective method of improving both response rate and reliability of the data (Zhao, Flynn and Yeung 2007). Furthermore, the initial contact helped us for instance to identify those companies, and their managers that worked closely together with suppliers and/or customers and as such were in our target group. The next step was to send the questionnaire to all participants via e-mail. Following Dillman's (1978) total design method for survey data collection, follow-up phone calls have been made in order to maximize the response rate. The final results included 56 responses or 112 strategic alliances, for a response rate of 18.7% of the initial contact sample of 300 managers.

We allowed respondents to decide whether to focus on supplier or customer strategic alliances, since we believe that most managers have no in-depth experience with both supplier and customer alliances. We believe this leads our respondents to give more accurate responses than when asked to simultaneously fill out a survey for both an upstream supplier and a downstream supplier as in Frohlich and Westbrook (2001). Of the 112 strategic alliances, 34 alliances focused on customer-alliances (downstream) and 78 focused on supplier-alliances (upstream).

Table 4.1 provides a demographic overview of the sample, which consists of companies in the primary goods, chemical, pharmaceutical, consumer goods, media and informatics industries.

The largest groups in the sample are the chemical and consumer goods industries. This is representative of Belgian industry which possesses a large proportion of firms in these industries. The sample is biased towards larger companies, which is acceptable since the goal of the study is to focus on larger firms. In addition, the sample is biased toward supplier relationships with 68% of the respondents describing an upstream relationship. This may be a function of the job positions of the respondents, which are supply chain focused, and thus more likely to look upstream than downstream.

We checked our responses for missing data. Since less than 5% of the data were missing and since these were randomly missing, we employ the conservative approach of listwise deletion to handle missing data.

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Insert Table 4.1 about here

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In order to assess the potential for non-response bias we tested for significant differences between early and late respondents as prescribed by Armstrong and Overton (1977). Employing a significance level of  $p < 0.05$ , no differences were found at a 95% level between the early and late respondents. These results indicate that there is no reason to believe non-response bias is present in the data (e.g. Vaidyanathan and Devaraj 2008).

### **4.3.2 Scales**

Where possible, the scales are based upon existing scales in the literature. Pre-testing of the questionnaire was conducted using a sample of 10 experts (academics and people in the field). The pre-testing provided support for the face validity of the constructs and resulted in a few minor changes in wording and presentation of items. The questionnaire was administered in English to prevent possible interpretation errors.

We performed exploratory factor analyses with principal components and varimax rotation on three sets of scales: Information flow characteristics, Integration characteristics and Performance. 4.2 shows the results of the factor analysis of the Information flow characteristics. The other factor analyses can be found in Appendix. The measures are described in the following paragraphs.

#### **4.3.2.1 Information flow characteristics**

Based on the literature review, in combination with a factor analysis, we employ three constructs to capture the information flow characteristics. Information quality and Information sharing are scales adapted from previous research by Mohr et al. (1994) and Monczka et al. (1998), who measured the antecedents of strategic alliances. The respondents were asked to rate a set of statements on a 1-7 likert scale, ranging from completely disagree (1) to completely agree (7). The constructs have been shown to be reliable and valid. The third scale employed to assess the information flow characteristics are the IT supply chain applications. The items in this scale are selected based on a review of recent literature. We feel that developing our own construct is appropriate given the rapidly changing area of IT applications. The goal was to capture current technologies and achieve good construct validity. The use of IT supply chain applications was measured by asking respondents to rate the extent to which they used the following technologies in their alliance: Information exchange systems including EDI, POS on the web and internet



(Cagliano et al. 2003); planning systems such as ERP/MRP/MRP II and DRP systems and collaboration databases such as CRM and SRM databases. A 1 to 7 scale was used, with (1) no use and (7) highly used. Descriptive data for Information Flow Characteristics is shown in Table 4.2. The data indicate that the firms in our study place the least emphasis on IT supply chain applications, as the mean for this scale is substantially lower (3.15) than for Communication quality (5.01) and Information sharing (4.94). Table 4.2 also shows that the Cronbach's alpha for all three constructs is above the cut-off level of 0.70, indicating acceptable reliability (Nunnally 1978, Churchill 1979).

#### **4.3.2.2 Relational characteristics**

As stated in the literature review, we measure relational characteristics using two constructs: trust and interdependence. These constructs are based on scales developed by Mohr et al. (1994) and Monczka et al. (1998). Each construct consists of 4 items and can be found in Appendix A. Cronbach's alpha is 0.93 and 0.80 for Trust and Interdependence respectively.

#### **4.3.2.3 Performance of the alliance**

Advanced forms of supply chain integration such as Coordination, Information participation and Constructive conflict resolution all require an extensive degree of quantitative information flow and facilitate the use of the information flows in the relationship. Coordination and Information participation both consists of 3 items. The Cronbach's alpha is 0.83 for Coordination and respectively 0.71 for Information participation. Constructive conflict resolution consists of two items and has a bivariate correlation of 0.52.

The items and the reliability for Relationship satisfaction and the Operational capabilities can be found in Appendix B. Relationship satisfaction consists of 4 items and has a Cronbach's alpha of 0.94. The bi-variate correlations for the Operational capabilities are between 0.61 and 0.92.

Both Relationship satisfaction and the Operational capabilities are subjective measures rather than objective financial data. These types of measures are commonly used in operations and supply chain research, since managers are often reluctant to provide confidential information regarding performance. Previous researchers (Boyer et al. 1996, Randall et al. 2001) tested the correlation between the subjective and objective measures, and found evidence to support the reliability of subjective performance measures to predict more objective measures.

#### 4.3.2.4 Validity and reliability of measurement scales

We assess scale validity and reliability of our survey instrument in three ways: content validity, construct validity and reliability. Content validity refers to the degree to which the scales properly reflect the different integration constructs and measure the performance improvements of a specific relationship. As stated earlier, the survey was developed based on a comprehensive literature review. In addition, our scales are based on earlier published work of Mohr et al. (1994) and Monczka et al. (1998).

Convergent and discriminant validity of our scales is assessed by exploratory factor analyses. Table 4.2 shows the results of the factor analysis of the Information flow characteristics. The three factors derived in the factor analysis showed eigenvalues higher than 1 and account for 71.39 % of the variance. As described in the literature review, we labeled the factors as Information sharing, Information quality and IT supply chain applications. The factor analyses for integration characteristics and performance can be found in Appendix A and B. The items omitted from the analysis are indicated by a star (\*). We omitted these items since their factor loading proved to be too small ( $< 0.50$ ) (Hair et al. 1998) or since they had high loadings on more than one factor. The final factor loadings of the constructs are provided in the Appendix. All factor loadings are between 0.55 and 0.87 and are significant. Also unidimensionality is supported since all factors have eigenvalues greater than 1. Appendix A shows that the 5 factors of integration accounted for 75.92% of the variance. As described in the literature review, we labeled the factors as Trust, Interdependence, Information participation, Coordination and Conflict resolution. Furthermore, the 6 factors presented in Appendix 2 measure performance, accounting for 87.37% of the variance. These factors are labeled as Relationship satisfaction and the 5 operational capabilities: Cost, Flexibility, Delivery, Quality and Innovation.

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Insert Table 4.2 about here

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We computed the inter-factor correlations as shown in Table 4.3. No extreme correlations were found, indicating acceptable discriminant validity.

To guarantee reliability, several variables have been measured through multiple item measures. Scale reliability is the percent of variance in an observed variable that is accounted for by the true score of the latent factor or underlying construct ( DeVellis 1991). Cronbach's alpha is most commonly used to reject or confirm the assumption that some theoretical constructs underlie the items (Carmines and Zeller, 1979). As mentioned before, all Cronbach's alpha scores are between 0.71 and 0.94 (see Appendix), exceeding the lower threshold of 0.70 for existing constructs (Nunally 1969, Murphy and Davidshofer 2001).

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Insert Table 4.3 about here

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## **4.4 Data analysis**

Our analysis consists of three steps. First, we analyze the characteristics of the information flows of the strategic alliances by using cluster analysis. This enables us to test proposition 1. The cluster analysis develops a taxonomy of strategies towards information flows in strategic alliances. In step two, we examine the relationship between the context and the information flow strategy to determine the extent to which they explain the differences in choosing different Information flow strategies. By doing so, we test proposition 2. In the final step, we analyze the performance of the different information flow strategies. We examine how the information flow strategies relate to facilitating strategies for integration such as Coordination, Information participation and Constructive conflict resolution techniques. We also test the link between information flow strategies and both the Operational capabilities and the level of overall satisfaction with the relationship. These are stated in proposition 3.

### **4.4.1 Information flow strategies**

To evaluate our first proposition, a cluster analysis is performed on the three information flow characteristics: Information quality, Information sharing and IT supply chain applications. The goal is to classify the complete sample into several groups or subsets of strategic alliances having similar patterns of use of information flows. A two-stage procedure, as suggested by Ketchen and Shook (1996), has been followed to create our subsets of firms with similar information

flows. This two-stage procedure first applies Ward's hierarchical clustering method, followed by a K-means clustering. The number of clusters as suggested by the hierarchical clustering is then used as a parameter in the nonhierarchical K-means clustering method with Euclidian distance measure. This K-means clustering is preferred over the hierarchical clustering because it is an iterative partitioning method and compensates for a poor initial partitioning of the hierarchical clustering. Research has shown that this procedure increases the validity of the solutions (Milligan 1996).

To determine the number of clusters, we used multiple techniques (Ketchen and Shook 1996): some rule of thumb, inspection of the dendrogram and the agglomeration coefficient. The objective of cluster analysis is generally to make a balanced choice between parsimony and accuracy. First, Lehmann (1979) suggests that the number of clusters should be between  $n/30$  and  $n/60$ , with  $n$  being the sample size. Since our sample size is 112, this rule suggests approximately 2 to 3 clusters. Based on the visual inspection of the dendrogram and more specifically the 'rescaled distance cluster combine' measure, we chose three clusters to be an attractive choice. A final criterion for choosing the appropriate number of clusters involves the managerial interpretability of the solution. To assess the differences across the groups, a one-way ANOVA was performed to test for differences between individual pairs of groups. Table 4.5 provides the data for the cluster means, standard errors, the F test and significance level of the ANOVA, as well as the post-hoc Scheffe's pairwise comparisons. The results indicate that the groups represent three significantly different clusters at the  $p < 0.01$  level. Each of these clusters represents an approach or strategy towards the information flow between two firms in the supply chain. We have labeled the three groups: Silent, Communicative and IT intensive alliances, each describing a distinct strategy towards the foundations of integration. The rationale for the names is discussed in the section below. A first analysis shows that successful alliances represent a high portion of the IT intensive alliances (21 out of 25 = 96%), while the unsuccessful alliances are often categorized as Silent alliances (30 out of 38 = 78.9%).

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Insert Table 4.4 about here

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#### **4.4.1.1 Silent alliances**

The 38 cases in this cluster have the lowest means on all three scales. The Scheffe tests in Table 4.4 indicate that these companies have the lowest means for both Information quality and Information sharing, which are statistically different from the other two groups. With respect to IT supply chain applications, the mean for Silent alliances is significantly lower than the group labeled IT intensive alliances, but equivalent to the group labeled Communicative alliances. In essence, the Silent alliances are the least advanced group in terms of supply chain information flow. Interestingly, this is also the largest group, indicating that still a lot of strategic alliances do not make substantial efforts to share information across the supply chain. We consider these alliances to represent the ‘base case’ with respect to strategic alliances. Our expectation is that this group will exhibit worse performance than the other two groups.

#### **4.4.1.2 Communicative alliances**

The Scheffe pairwise comparison procedure indicates that this cluster has levels of Information sharing and Information quality that are similar to the IT intensive alliances, but that these levels are significantly higher than those for the Silent alliances. What sets this group apart is that its level of technology usage is significantly lower than the IT intensive alliances. In essence, this group works hard to integrate with its alliance partner, with a minimal usage of technology. We have labeled this cluster the Communicative alliances.

#### **4.4.1.3 IT intensive alliances**

IT intensive alliances have the highest scores on all information flow characteristics. As noted earlier, both Information quality and Information sharing are statistically higher than for the Silent alliances, but equivalent to the Communicative alliances. The distinguishing feature of this group is that it has, by far, the highest usage of technology with a mean for IT supply chain applications of 4.72, which is significantly higher than the other two groups. Our priori expectation is that this group will have higher levels of performance than the Silent alliances, but we are less confident that they would show higher performance than the Communicative alliances.

## **4.4.2 Contextual factors**

Having developed a taxonomy of strategies regarding information flows, we now turn to potential contextual and performance factors. We note that while the groups seem to make intuitive sense, a cluster analysis will always develop some groups with substantial differences. Thus, one of the methods for validating these groups is to examine other variables not included in the initial cluster analysis (Boyer et al. 1996).

### **4.4.2.1 Firm size**

We measure firm size by the numbers of employees of the responding firm. Table 4.5 shows the results of a chi-square test with the number of employees as dependent variable and the three clusters as independent variable. The chi-square test for number of employees is significant at the  $p < 0.10$  level. We consider this to be reasonable given our small sample size. This is an interesting finding since it suggests that there is a positive correlation between size and investment in information flows.

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Insert Table 4.5 about here

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### **4.4.2.2 Business context**

More competitive environments require a more responsive supply chain. Consequently, more competitive environments imply the use of more advanced forms of information flow integration. More specifically, these alliances are more likely to be clustered as IT intensive or Communicative alliances. The analysis in Table 4.6 suggests that alliances experiencing more competition on quality and on design and development, are more likely to be clustered as IT intensive alliances. Therefore, we can conclude that relationships in highly competitive environments with a high focus on quality and design and development are more likely to invest in IT supply chain applications for communication with partners.

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Insert Table 4.6 About Here

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#### 4.4.2.3 Relationship characteristics

As explained in the literature, we examine the strategic alliances by their level of Trust and Interdependency. Table 4.7 shows an ANOVA for Interdependence and Trust. The data shows that the degree of Interdependence is much higher for IT intensive alliances than for the other two groups. Furthermore, both IT intensive and Communicative alliances show higher levels of Trust than Silent alliances.

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Insert Table 4.7 about here

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#### 4.4.3 Performance of the alliance

Table 4.8 shows clear differences among the information flow strategies in terms of use of advanced forms of supply chain integration, all at the  $p < 0.01$  level. The Silent alliances have the lowest mean for all three scales: Coordination, Information participation and Constructive conflict resolution. Our analysis indicates that two strategies, i.e. IT intensive and Communicative alliances, use similar degrees of Coordination and Conflict resolution techniques. Therefore, it can be concluded that alliances can be integrated either with or without specific IT supply chain applications. On the other hand, the analysis shows that there is a significant difference between these two groups in terms of Information participation, indicating that the level of Information participation depends upon the IT supply chain applications used in alliances. This provides support for our taxonomy of Information flow strategies as being real foundations for supply chain integration.

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Insert Table 4.8 about here

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Table 4.9 provides the means for each of the performance benefits, separated by the information flow strategy groups. Overall, the IT intensive alliances have the best performance benefits, with significantly higher performance on Cost, Flexibility, Delivery, Quality and Innovation. In turn,

the Communicative alliances have significantly higher scores for Cost, Flexibility and Quality than the Silent alliances. However, our analysis shows no differences in Relationship satisfaction between the IT intensive and Communicative alliances, albeit significantly higher values than the Silent alliances.

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Insert Table 4.9 about here

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In summary, we could state that our analyses identify three strategies for integrating information flows in a strategic alliance. We labeled these strategies as Silent, Communicative and IT intensive alliance strategies. Silent alliances, on the one hand, are characterized by low levels of information flows. Communicative and IT intensive alliances, on the other hand, share high levels and high quality of information in the supply chain, with the IT intensive alliances using significantly higher levels of IT to share this data. The results suggest that the choice of the information flow strategy depends on the business and relational environment of the strategic alliance and may affect the performance of the alliance. Table 4.6 shows that IT intensive alliances are more prominent in innovative alliances. Furthermore, our analyses suggest that the use of IT in the alliance depends on the interdependence between the partners, while the level of trust determines the level of information sharing and the quality of the shared information.

Our results confirm that Communicative and IT intensive alliances perform better than Silent alliances. While Communicative and IT intensive alliances report similar levels of Relationship satisfaction, they do differ in Performance benefits. Investing in IT applications in an alliance is shown to improve costs, deliveries, quality, innovation and flexibility. Furthermore, not all advanced forms of integration are positively affected by investments in IT supply chain applications. We did not find an effect of IT supply chain applications on the coordination and the use of constructive conflict resolution techniques in the supply chain.



## 4.5 Discussion

The study presented in this paper highlights the existence of different information flow strategies for integrating strategic alliances. A few studies have already proposed some contingencies of information flows, but they are generally based on conceptual thinking or case studies of best practices. The present work, instead, is based on survey data, enabling us to test some of the propositions. These strategies have been explored in terms of contextual factors and in their relationship with broader aspects of performance.

The value of the study is twofold. It contributes to the current research on inter-firm information sharing and supply chain practices in strategic alliances and it provides insightful information for managers.

Our study shows different information flow strategies for integrating strategic alliances, which are defined as long-term, go beyond traditional relationships in terms of benefits and are beneficial for both parties. The results show that inter-organizational information integration in these strategic alliances is not well advanced despite the development of some advanced forms of supply chain integration. In addition, our study shows that many firms do not invest in technology to integrate the information flow and as such are not integrated in a structural way. A study of Carr and Kaynak (2007) showed that these advanced communication methods, such as IT supply chain applications, are not critical with respect to influencing inter-firm information flows and that partners still share a lot of information through non-integrative systems like fax, phone and e-mail. However, we find that a third of the strategic alliances do not even share information in a regular way. Although practitioners as well as academics advocate the use of strategic alliances and how these should be integrated, still few alliances really succeed in doing so. Furthermore, we see that strategic alliances with limited information flows are perceived as being less successful.

A success factor for information flow strategies is the coherence with the context of the firm and the alliance. In the literature, IT supply chain applications are considered 'lean' rather than 'rich', as they are still predominantly written and numerical representations of data (Stephens 2007). In less ambiguous environments, communication can be managed using less rich media (Donabedian 2006). However, Harland et al. (2007) found, based on interviews, that IT supply chain applications can enhance relationships by freeing up time from administrative tasks which

can then be used to spend more time for building the relationship. Our data confirms this latter view and shows that IT supply chain applications are used in environments that are highly dynamic. Furthermore, it indicates that IT supply chain applications do not replace the more traditional communication such as phone, fax and e-mail, but rather are an additional medium for partners to communicate and also create advanced forms of integration such as joint planning activities and joint goal setting.

Additionally, our results suggest that information flow strategies co-evolve with the creation of trust and interdependence in the strategic alliance. While high levels of trust seem to create an environment to share information, interdependence creates the willingness to invest in IT supply chain applications. The results also show that partners first need to invest in information sharing processes based on traditional media and to create trust, before evolving towards investing in IT supply chain applications.

However, it is important to stress that not all strategic alliances need to develop towards IT intensive alliances. This statement is supported by previous research of Das et al. (2006) who argue that the optimum supply chain performance will only be achieved through the appropriate, and not necessarily highest, level of supply chain integration. As mentioned above, this appropriate level depends on the business and relational environment of the strategic alliance.

Based on these results, some managerial implications can be drawn.

Despite the ideal that supply chain integration is always beneficial (e.g. Currie 2000), the findings of our study suggest that a universal approach to inter-firm information flows could hinder effective communication. This finding is also supported by Harland et al. (2007), who suggest that managers should be smarter in their IT integration initiatives. One example involves promoting IT supply chain applications in all circumstances. While more advanced information flow strategies seem to pay off, this might not be the optimal strategy for every strategic alliance. Our study shows for instance that strategic alliances are more likely to invest in IT supply chain applications in more dynamic environments and in environments with higher levels of interdependence among partners. Consequently, these investments in IT should be in line with the overall integration strategy, the company's product portfolio and the supply chain configuration (Silveira et al. 2004) which also takes softer (e.g. relational characteristics), less technological forms (e.g. business characteristics) of integration into consideration.

The study also shows that companies need to think about their supplier and customer management strategy in a systematic way before setting up strategic alliances. It often happens that companies decide to work more closely together, dazzled by the potential benefits, without a clear strategy or motivation. Some suppliers might be for instance motivated by seeing a strategic alliance as a way to secure the demand, but not actually as a way to optimize and integrate supply chain processes. As such, a lot of strategic alliances are unsuccessful and even do not succeed in setting up information flows between the partners. A more systematic approach, in which both parties make a clear selection of the partners with whom they want to integrate and discussions about the motivation and expectations of both partners, might hinder this rush into strategic alliances.

Our study also shows that strategic alliances can only be successful in an environment with high levels of trust. Managers should thus first work on the level of trust before setting up strategic alliances. These higher levels of trust result from personal contacts with the partner.

Finally, before investing in IT supply chain applications, managers need to think about which outcomes they hope to accomplish and how these practices can help the company to reach these outcomes. Far too many companies hope to replace the traditional communication systems such as face-to-face contact and phone calls, by standardized IT supply chain applications. Since strategic alliances still build on trust, personal contact can not be replaced by these IT supply chain applications. While IT supply chain applications might often be successful in more traditional relationships, companies are often disappointed by the limited cost/benefit ratio of IT supply chain applications in strategic alliances.

## **4.6 Conclusions and opportunities for future research**

This study contributes to the literature on strategic alliances by examining the role of information flows in these strategic alliances. The results of the study show that the information flow strategy is highly dependent on the relational characteristics and the business context of the strategic alliance. Like most empirical work, this study has limitations that might be addressed by further research. First of all, this study is focused on strategic alliances, thus excluding traditional buy-sell relationships. Since we believe that relationships differ according to the specific context, we believe this approach to be insightful. Future studies, however, could focus on other types of

relationships. In addition, alliances are measured by taking into account the view of only one of the parties. Generalizing these results towards the alliance may misrepresent the actual state of the alliance. Future research should address this issue by collecting dyadic data. Third, since we use cross-sectional data for our analysis, we can not prove causality. Instead, we infer that contextual factors may lead to certain strategic choices, while the information flow strategies may lead to differences in performance. However, we note that to definitively address this issue we need longitudinal data. Finally, our results are limited to strategic alliances of manufacturing firms. Service contexts are characterized by more ambiguity, uncertainty and variability and the use of different communication media (Ambrose et al. 2008), which may impact the information flow strategies. As such, we can not generalize our findings towards service companies. The same holds for the geographical context. The cases have been limited to Belgian firms to avoid cultural differences. Whether the conclusions still hold in other areas is unexplored and can be subject to future research.

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## Tables and figures

Figure 4.1: Model of contextual and performance factors of the foundations of supply chain integration

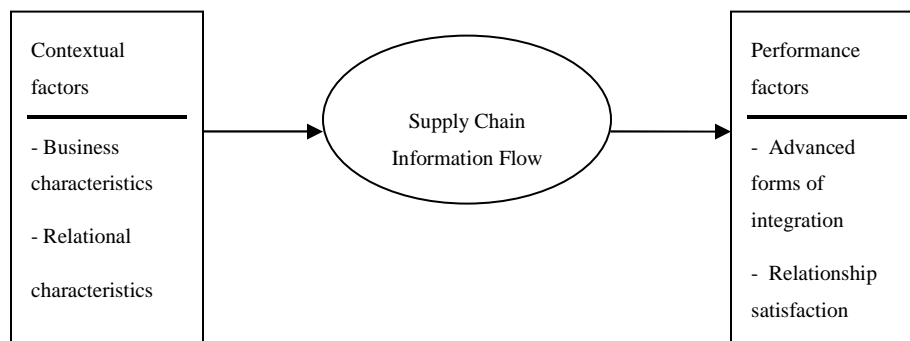


Table 4.1: Demographic Characteristics of the respondents and respondent function

<b>Type of relationship:</b>	<b>Companies activity:</b>
- Customer: 18 (32%)	- Chemical: 26 (46%)
- Supplier: 38 (68%)	- Consumer goods: 11 (19%)
<b>Annual sales:</b>	- Primary industry: 8 (14%)
- < 25 million €: 2 (4%)	- Informatics and media: 7 (12%)
- 26-50 million €: 6 (11%)	- Pharmaceuticals: 4 (8%)
- 51-100 million €: 7 (12%)	<b>Position in the supply chain:</b>
- 101-500 million €: 18 (32%)	- Upstream: 13 (25%)
- > 500 million €: 23 (41%)	- Manufacturing: 34 (61%)
<b>Number of employees:</b>	- Downstream: 8 (14%)
- 51-250: 8 (15%)	<b>Length of the collaboration:</b>
- 251 -500: 18 (32%)	- Average: 8.61 years
- 501-1000: 9 (16%)	- Standard error: 7.64
- > 1000: 21 (37%)	
<b>Function of respondents:</b>	
- Supply chain Manager or Director: 30	
- Purchasing Manager or Director: 7	
- Logistics Manager or Director: 19	

**Table 4.2: Information flow characteristics – Exploratory factor analysis**

Variables	Factor 1 Information quality	Factor 2 Information sharing	Factor 3 IT SC applications	Mean	Std. dev.
Communication is reliable	<b>0.90</b>	0.12	0.20	5.06	1.59
Communication is complete	<b>0.89</b>	0.18	-0.01	5.00	1.58
Communication is exact	<b>0.91</b>	0.22	0.07	4.95	1.57
Communication is on time	<b>0.88</b>	0.12	0.12	5.05	1.53
Communication is appropriate	<b>0.80</b>	0.25	-0.05	5.01	1.43
We inform partner in advance of changes	0.14	<b>0.81</b>	0.05	5.55	1.39
Both parties share all usefull information	0.16	<b>0.74</b>	0.12	5.70	1.26
We share confidential information with partner	0.41	<b>0.63</b>	0.05	4.26	1.92
Partner shares information with us	0.06	<b>0.55</b>	0.15	4.25	1.74
Planning systems	0.16	0.30	<b>0.76</b>	3.71	1.32
Information exchange systems	0.03	-0.01	<b>0.89</b>	3.32	1.76
Databases for collaboration	0.07	0.39	<b>0.58</b>	2.41	1.34
Eigenvalues	4.42	2.47	1.68		
Percent of Variance Explained	36.87	20.55	13.97		
Cumulative Percent	36.87	57.42	71.39		
Cronbach's alpha	0.94	0.79	0.74		
Mean	5.01	4.94	3.15		
Std. dev.	1.39	1.26	3.15		

Note: Each factor shows the mean of all respondent's answers on a seven-point scale asking wether they agree with the following statements, with 1 = completely disagree and 7 = completely agree for the first 2 constructs. For the IT SC Applications, the use of different IT applications in the specified relationship is measured with 1 = not used and 7 = highly used.

**Table 4.3: Scale inter-correlation matrix**

	Mean	SD	1	2	3	4	5	6	7	8
1. Information sharing	4.94	1.26	1							
2. Information quality	5.01	1.39	.57**	1						
3. IT SC applications	3.15	1.15	.42**	.25*	1					
4. Interdependence	4.19	1.55	.32**	.27**	.37**	1				
5. Trust	4.51	1.63	.56**	.61**	.31**	.15	1			
6. Coordination	4.19	1.30	.56**	.55**	.22*	.23*	.68**	1		
7. Information participation	4.76	1.18	.76**	.59**	.44**	.25*	.54**	.50**	1	
8. Constructive conflict resolution	5.84	1.08	.44**	.49**	.23*	.04	.49**	.44**	.43**	1

\*\* significantly different at p < .01 (2-tailed)

\* significantly different at p < .05 (2-tailed)

**Table 4.4: Information flow clusters**

Measure	Supply chain information flow strategies			
	Silent alliances <i>n</i> = 38	Communicative alliances <i>n</i> = 36	IT intensive alliances <i>n</i> = 25	
Information Quality	(2,3)	(1)	(1)	
Cluster Mean	3.57	<b>5.84</b>	<b>5.96</b>	F = 78.31
Standard Error	0.16	0.11	0.20	p < 0.001
Information Sharing	(2,3)	(1)	(1)	
Cluster Mean	3.84	<b>5.47</b>	<b>5.97</b>	F = 54.59
Standard Error	0.15	0.15	0.14	p < 0.001
IT SC Applications	(3)	(3)	(1,2)	
Cluster Mean	2.64	2.61	<b>4.72</b>	F = 80.88
Standard Error	0.12	0.09	0.17	p < 0.001

Note: Numbers in parentheses indicate the group numbers from which this group was significantly different at the  $p < 0.05$  level according to the Scheffe pairwise comparison procedure. F statistics and associated p-values are derived from one-way ANOVAs.

**Table 4.5: Company size**

Number of employees	Supply chain information flow strategies			Total
	Silent alliance	Communicative alliance	IT intensive alliance	
Less than 500	<b>22</b>	15	9	46
501-1000	3	<b>9</b>	3	15
Over 1000	12	11	<b>13</b>	36
Total	37	35	25	97

Note: A chi-square test of the sample distribution against the expected distribution based on a random distribution does indicate a significant difference ( $p < 0.10$ ).

The numbers in **bold** represent the cells with greater than expected proportions.

Table 4.6: Business context

Measure	Supply chain information flow strategies			
	Silent alliance <i>n</i> = 38	Communicative alliance <i>n</i> = 33	IT intensive alliance <i>n</i> = 25	
<i>Competition on costs</i>				
Cluster Mean	4.29	4.36	4.44	F = 0.27
Standard Error	0.13	0.11	0.19	p = 0.75
<i>Competition on quality</i>				
Cluster Mean	(3) 3.53	(3) 3.61	(1,2) <b>4.40</b>	F = 7.85
Standard Error	0.17	0.15	0.14	p < 0.01
<i>Competition in response speed</i>				
Cluster Mean	3.87	3.74	4.12	F = 1.96
Standard Error	0.11	0.12	0.17	p = 0.15
<i>Competition in design and development</i>				
Cluster Mean	3.55	(3) 3.33	(2) <b>4.04</b>	F = 3.58
Standard Error	0.18	0.17	0.18	p = 0.03
<i>Speed of change</i>				
Cluster Mean	3.34	3.56	3.56	F = 0.90
Standard Error	0.13	0.11	0.17	p = 0.41
<i>Foreign competition</i>				
Cluster Mean	4.39	4.11	4.36	F = 1.34
Standard Error	0.12	0.15	0.15	p = 0.27

Note: Numbers in parentheses indicate the group numbers from which this group was significantly different at the  $p < 0.05$  level according to the Scheffe pairwise comparison procedure. F statistics and associated p-values are derived from one-ways ANOVA's.

Table 4.7: Relationship characteristics

Measure	Supply chain information flow strategies			
	Silent alliance <i>n</i> = 38	Communicative alliance <i>n</i> = 33	IT intensive alliance <i>n</i> = 25	
<i>Interdependence</i>				
Cluster Mean	(3) 3.77	(3) 4.20	(1,2) <b>5.48</b>	F = 11.06
Standard Error	0.25	0.24	0.25	p < 0.01
<i>Trust</i>				
Cluster Mean	(2,3) 3.45	(1) <b>4.96</b>	(1) <b>5.75</b>	F = 25.02
Standard Error	0.20	0.26	0.19	p < 0.01

Note: Numbers in parentheses indicate the group numbers from which this group was significantly different at the  $p < 0.05$  level according to the Scheffe pairwise comparison procedure. F statistics and associated p-values are derived from one-ways ANOVA's.

Table 4.8: Supply chain integration

Measure	Supply chain information flow strategies			
	Silent alliance <i>n</i> = 38	Communicative alliance <i>n</i> = 33	IT intensive alliance <i>n</i> = 25	
Coordination	(2,3)	(1)	(1)	
Cluster Mean	4.14	<b>5.40</b>	<b>5.91</b>	F = 20.69
Standard Error	0.20	0.21	0.16	p < 0.01
Information participation	(2,3)	(1,3)	(1,2)	
Cluster Mean	3.88	5.03	<b>5.73</b>	F = 19.87
Standard Error	0.16	0.15	0.15	p < 0.01
Constructive conflict resolution	(2,3)	(1)	(1)	
Cluster Mean	5.29	<b>6.21</b>	<b>6.36</b>	F = 15.09
Standard Error	0.17	0.14	0.10	p < 0.01

Note: Numbers in parentheses indicate the group numbers from which this group was significantly different at the p < 0.05 level according to the Scheffe pairwise comparison procedure. F statistics and associated p-values are derived from one-ways ANOVA's.

Table 4.9: Supply Chain Performance

Measure	Supply chain information flow strategies			
	Silent alliance <i>n</i> = 38	Communicative alliance <i>n</i> = 33	IT intensive alliance <i>n</i> = 25	
<b>Relationship Satisfaction</b>	(2,3)	(1)	(1)	
Cluster Mean	3.43	<b>5.17</b>	<b>5.90</b>	F = 28.37
Standard Error	0.21	0.26	0.19	p < 0.01
<b>Competitive Capabilities</b>				
Cost	(2,3)	(1,3)	(1,2)	
Cluster Mean	2.82	3.91	<b>4.89</b>	F = 12.13
Standard Error	0.22	0.31	0.35	p < 0.01
Flexibility	(2,3)	(1,3)	(1,2)	
Cluster Mean	2.96	4.25	<b>5.19</b>	F = 16.97
Standard Error	0.22	0.29	0.27	p < 0.01
Delivery	(3)	(3)	(1,2)	
Cluster Mean	3.43	4.19	<b>5.36</b>	F = 10.92
Standard Error	0.24	0.33	0.21	p < 0.01
Quality	(2,3)	(1,3)	(1,2)	
Cluster Mean	3.01	4.13	<b>5.19</b>	F = 20.57
Standard Error	0.20	0.24	0.27	p < 0.01
Innovation	(3)	(3)	(1,2)	
Cluster Mean	2.28	2.72	<b>4.60</b>	F = 25.32
Standard Error	0.16	0.24	0.30	p < 0.01

Note: Numbers in parentheses indicate the group numbers from which this group was significantly different at the p < 0.05 level according to the Scheffe pairwise comparison procedure. F statistics and associated p-values are derived from one-ways ANOVA's. The numbers in **bold** represent mean values significant different from the other mean values.



# Appendices

## Appendix A: Descriptives and Factor analysis of the Integration Scales

Constructs	Mean	Std. dev.	Factor loading
<b>Trust</b> (Cronbach's alpha = 0.93)			
TR1: The alliance is beneficial for us.	4.79	1.79	0.87
TR2: The alliance achieved a balanced agreement.	4.47	1.82	0.86
TR3: The alliance has high level of business harmony.	4.17	1.75	0.79
TR4: The alliance offers significant benefits to both partners.	4.60	1.83	0.86
TR5: Duration expectancy of the alliance. (very short term versus very long term)*	5.02	1.54	-
Eigenvalue			3.59
Variance explained			22.42%
<b>Interdependence</b> (Chronbach's alpha = 0.80)			
I1: It is easy to end the alliance and start a new one. (inverted)	4.50	1.90	0.79
I2: Time to establish a new alliance will be extremely long.	4.29	1.99	0.87
I3: The cost of establishing a new alliance would be high.	4.23	1.79	0.8
I4: The alliance can easily be stopped without losses. (inverted)	3.76	2.11	0.75
Eigenvalue			2.85
Variance explained			17.82%
<b>Coordination</b> (Chronbach's alpha = 0.83)			
CO1: In this alliance, each party knows his exact role.	5.35	1.51	0.85
CO2: The collaborative practices are planned very carefully.	4.77	1.44	0.78
CO3: The degree of coordination in this alliance is extremely high.	4.80	1.58	0.58
Eigenvalue			2.03
Variance explained			12.71%
<b>Information Participation</b> (Cronbach's alpha = 0.71)			
IP1 : We are actively seeking for advice, guidelines and information from partner.	5.23	1.50	0.55
IP2: The partner takes part in planning activities and setting aims and goals.	3.96	1.83	0.75
IP3: We take part in planning activities, aims and goals of partner.*	4.38	1.76	-
IP4: We are actively seeking for proposals or suggestions for improvement from partner.	5.08	1.58	0.84
IP5: We react appropriately to a partner's suggestions.*	5.27	1.26	-
Eigenvalue			1.97
Variance explained			12.30%
<b>Constructive Conflict Resolution Techniques</b> (Bi-variate correlation = 0.52)			
CR1: joint resolution of problems	5.39	1.39	0.68
CR2: ignoring the problem (inverted)	6.28	1.06	0.87
CR3: Persuasion from any of the parties*	4.09	1.37	-
CR4: Unilateral imposition*	3.12	1.59	-
CR5: External arbitration*	5.56	0.89	-
Eigenvalue			1.71
Variance explained			10.67%

\* These items were dropped based on the explanatory factor analysis, based on high cross-loadings or low loadings (<0.50) on the factor.

## Appendix B: Descriptives and Factor analysis of the Performance Scales

<b>Relationship Satisfaction</b> (Cronbach's alpha = 0.94)			
SA 1: In this alliance, the parties work together to solve problems.	4.90	1.83	0.86
SA2: This alliance is flexible in response to requests we make.	4.5	1.77	0.86
SA3: This alliance makes an effort to help us during emergencies.	4.84	1.75	0.84
SA4: When an agreement is made, we can always rely on the partner to fulfill the requirements.	4.79	1.84	0.82
SA5: Please indicate the overall degree of satisfaction with your alliance.*	4.30	1.84	-
Eigenvalue			3.61
Variance explained			24.09%
<b>Flexibility</b> (Bi-variate correlation = 0.66)			
F1: increase flexibility	4.31	1.84	0.61
F2: reduce cycle time	3.71	1.86	0.77
Eigenvalue			2.86
Variance explained			19.11%
<b>Quality</b> (Bi-variate correlation = 0.92)			
Q1: improve product quality	3.84	1.72	0.87
Q2: improve quality reliability	3.89	1.79	0.84
Eigenvalue			2.11
Variance explained			14.08%
<b>Cost</b> (Bi-variate correlation = 0.84)			
C1: reduce product costs	3.71	1.87	0.85
C2: reduce process costs	3.80	1.91	0.75
C3: Reduced Inventories*	3.58	2.03	-
C4: More efficient use of HR*	3.75	1.87	-
Eigenvalue			1.83
Variance explained			12.23%
<b>Innovation</b> (Bi-variate correlation = 0.61)			
I1: increase speed to market for new products	2.98	1.82	0.73
I2: use of market data in a more efficient way	3.09	1.70	0.79
Eigenvalue			1.68
Variance explained			11.25%
<b>Delivery</b> (Bi-variate correlation = 0.77)			
D1: delivery speed	4.01	1.88	0.83
D2: delivery reliability	4.36	1.85	0.70
Eigenvalue			1.02
Variance explained			6.61%

\* These items were dropped based on the explanatory factor analysis, based on high cross-loadings or low loadings (<0.50) on the factor.

## Appendix C: Literature review on building alliances through economic incentives in the supply chain

The following paragraphs provide a discussion of some important works in the OM literature on building alliances through economic incentives. The review is not intended as a complete literature review, but summarizes some of the latest work in this field. The economic incentives, discussed in the next paragraphs, are information sharing (including forecasting information), contracting and pricing mechanisms and the design of the supply chain. The purpose of these economic incentives is to optimize the total supply chain performance and to distribute the gains fairly among the partners in the supply chain. Although modelling these supply chains and finding the optimum provide us insights into how managers can coordinate these supply chains efficiently are valuable, how the gains and performance are distributed among the partners depends on the specific settings of the case (or are in other words somewhat ‘stylistic’). As such, we believe that empirical studies, next to the economic incentive literature, might help to create a more holistic view.

### **Information sharing in the supply chain**

Sharing information has emerged as one of the most critical practices in improving the performance of supply chain. Cachon and Fisher (2000) for instance studied the value of sharing information. They showed that implementing information technology to accelerate and smooth the physical flow of goods through a supply chain is significantly more valuable than using information technology to expand the flow of information. They state that the VOI (value of information sharing) depends on how this information is used in the supply chain and not just on the amount of information that is shared. Furthermore, Cohen et al. (2003) showed that the supplier fears holding costs and order cancellations, making the supplier averse to commencing order fulfilment based on forecasting information. This undermines the effectiveness of the overall forecast-sharing mechanism (or in general the value of the information shared). Furthermore, the holding and order cancellation costs are perceived as much more important relative to the cost of delay. Since just sharing forecast information does not seem to significantly improve performance, Cohen et al. (2003) suggest that the overall supply chain

performance could be improved if the customer were willing to share some of the holding costs. Furthermore, forecasting suffers from some problems like forecasting volatility and forecast inflation. Terwiesch et al. (2005) study the relationship between the buyer's forecasting behaviour (in terms of frequency, volatility and inflation) and the supplier's delivery performance (the ability to meet the delivery dates). Based on this analysis, the authors showed that suppliers penalize buyers for unreliable forecasts by providing lower service levels. Vice versa, the authors also show that buyers penalize suppliers that have a history of poor service by providing them with overly inflated forecasts. While most of the studies focus on information sharing from the retailer to the manufacturer, Jain and Moinzadeh (2005) focused on sharing information in reverse order, i.e. from the manufacturer to the retailer on inventory availability. The analysis shows that also reverse information helps the retailer to reduce its inventory costs (around 10%) and may increase the manufacturer's profits. Finally, Li and Zhang (2008) pointed out that information sharing is not always beneficial for the buyer. They show that information sharing is only beneficial to the buyer if this information is treated confidentially. If this is the case, they showed that supply chain profit will achieve its maximum equilibrium.

### **Pricing and contracts in the supply chain**

If information asymmetries are present, complex contracts might provide a powerful signalling device that can improve performance. Van Mieghem (1999) for instance found that firms may be better off leaving some contract parameters unspecified ex-ante and agreeing to negotiate ex-post. Cachon (2004) looked more in-depth into advance-purchase discount contracts (i.e. contracts in which you receive a discount for purchases before the season and a regular price for replenishments during the selling season). Since previous studies have exaggerated the value of coordinating contracts such as buy-backs and revenue sharing because of only looking at just push models, Cachon (2004) looked at how purchasing discount contracts work in both push and pull environments. Furthermore, these advance-purchase discounts are also administratively cheaper than other types of contracts and have the same benefits. Next, Cachon and Liriviere (2005) describe how a revenue-sharing contract (i.e. the seller pays a price for each unit purchased plus a percentage of its revenue) coordinates a supply chain with sellers competing in quantities (i.e. Cournot competitors) and arbitrarily allocates the supply chain's profit. They

demonstrate that revenue sharing is a very attractive contract. These types of contracts coordinate a broader array of supply chains than buyback contracts (Pasternack, 1985). This type of contract is mainly used in the videocassette rental industry. In some industries, a revenue sharing contract provides only a small improvement over the administratively cheaper wholesale price contract or when the demand depends on costly efforts of the seller.

### **Supply chain design**

Balakrishnan et al. (2004) proposed a coordinated inventory replenishment policy (i.e. coordination among the multiple participating firms in using collaborative fulfilment networks) that uses order smoothing (such as exponential smoothing and moving weighted average policies) to reduce order-size variability and ultimately reduces the total inventory and transportation costs. The magnitude of these savings depends on several factors such as the variability in consumer demand, the level of product variety and the degree of inventory aggregation in the distribution system. Güllü et al. (2005), on the other hand, introduced a decentralized supply chain consisting of a supplier and two independent retailers. This model leads to considerable benefits in terms of expected costs (14% improvement) and safety stocks (16% improvement) and gains 70% of the expected cost benefits of a centralized model. As such, this system can improve performance as like a centralized model, but without sacrificing the individual performance of a retailer. The benefits are higher if the standard deviation of demand is relatively small and if the supplier lead time is long and the retailer lead time is short.

Furthermore, Schoenmeyr and Graves (2009) looked at the optimal location for safety stocks. They found that the optimal placement of supply chain safety stocks is driven by three different (sometimes contradicting) principles: (1) economies of scale encouraging the use of fewer and larger safety-stock buffers, (2) value-adding activities encouraging the use of more numerous, smaller and distributed safety stocks and (3) when using a forecast-based ordering policy the safety stocks depends on the size of the forecast errors rather than the variability of demand.

Su (2009) analyzed customer return policies. He found that full refunds are too generous and do not optimize supply chain performance. Furthermore, the author also suggest to (i) use different buy-back rates for new and returned items, (ii) have consumers return products directly to the manufacturer and (iii) offer sales rebates to the retailer. However, these suggestions require some additional monitoring capabilities of the manufacturer.

## **Not only economic incentives, but also social preferences impact supply chain decisions**

A recent study of Loch and Wu (2008) provided experimental evidence that social preferences systematically affect economic decision making in supply chain transactions. More specifically, supply chain parties deviate from the predictions provided by 'rational' profit-maximization models, based on social preferences, such as concerns about the other party's welfare, reciprocating a history of a positive relationship and a desire for a higher relative payoff compared with the other party's when status is salient.

In summary, we could state that both economic incentives and more behavioural characteristics (such as social preferences) impact supply chain decisions and eventually supply chain performance.

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# Chapter 5: Supplier integration capability: A conceptualization and test

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Previous research described supplier integration as a resource which can be used by the buying company to create economic rents. We seek to build on this work by identifying three capabilities that supplier integration practices enable: sensing, seizing, and transforming capabilities. Further, we use Teece's (2007) framework to examine how these three sub-capabilities can together form a dynamic capability we call Supplier Integration Capability (SIC), which enables the buyer to sense changes in the environment, seize upon opportunities presented, and make long term changes to internal processes as it learns to compete. We empirically examine this framework on a large sample (n = 631) of companies in the manufacturing of metal products, machinery and equipment industry using structural equation modeling. This study identified one set of complementarities for SIC derived from the dynamic capability literature. Furthermore, the analysis reveals that a SIC model better represents the data than an alternate model in terms of both parsimony and fit. Finally, SIC positively influences both process flexibility and cost efficiency, which are related to market performance and financial performance respectively.

Keywords: supplier integration, dynamic capability, survey research

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## 5.1 Introduction

A recent study of the U.S. department of commerce estimated the economic impact of inadequate infrastructure for supply chain integration to be in excess of \$5 billion for the automotive industry, and almost \$3.9 billion for the electronics industry, which represents about 1.2% of the value of shipments in each industry (White and O'Connor and Rowe 2004). In the past ten years, academics have begun to realize the complexity and importance of supply chain integration, and scholarly studies on supply chain integration have multiplied.

Different categorization schemes have been applied so as to isolate the effectiveness of different integration efforts. Integration can refer to anything from product development activities to collaborative forecasting to strategic planning. Studies falling under the supply chain integration area have examined the effects of these types of integration and others. Often, they have



considered supply, supply chain, and customer integration resources to either directly or indirectly contribute to performance aspects of the focal firm. The work of these OM researchers has concentrated on confirming the positive link between the level of one or more types of supply chain integration and the performance of the focal firm (e.g. Swink et al. 2007, Vereecke and Muylle 2006, Frohlich and Westbrook 2001).

A firm that seeks the benefits of integration, however, is not likely to be best served by integrating in all manners without regard to the integrative capabilities that a particular type of integration can enable. Even if ignoring capabilities were advisable, justifying integration efforts within a firm requires tying integration types to capabilities so that the direct benefits can be understood. An integration practice does not have value in and of itself. Its value is derived from the integrative capabilities it enables, and these are what managers seek to achieve when they implement practices.

The number of capabilities derived from supply chain integration practices are many. This study limits its scope to three: sensing, seizing, and transforming capabilities. The reason for concentrating on these three capabilities is that Teece (2007) has identified them all as sub-capabilities of a dynamic capability. A dynamic capability is a special type of capability that allows a firm to adapt to environmental changes over time. Thus, these three capabilities are particularly important to sustain competitive advantage. The aim of this paper is to identify and test for the presence of a Supplier Integration Capability that can lead to different supplier integration types defined in accordance with the dynamic capability literature.

There is evidence that integration practices can be applied in a way that allows a firm to adapt to environmental changes. Evans et al. (1995) for instance point out that integration is used by companies to adapt to change, and that it involves the reconfiguration of resources. In other words, it is not just about picking the right resources, but also about the ability to deploy integration resources in a way that they may help companies adapt to change.

An example of the Supplier Integration Capability being used to reconfigure supply chain resources is Toyota's quick recovery from a fire at its brake valves supplier (Reitman 1997). To be able to change to the new situation, Toyota called upon its close-knit family of part suppliers and reconfigured the supply chain strategy by asked the suppliers to start up small production units to deliver the needed brake valves. This process called upon several routines of Toyota: (1)

efficient, on-time information sharing helped them to detect the problem in a timely way, (2) procedures allowed them to react quickly, and (3) fast transforming practices made it possible for Toyota to solve the problem of restarting supply of the brake valves. Toyota exhibited its dynamic response competence by (1) sensing environmental changes, (2) seizing opportunities by making investments and (3) transforming their supply chain to help the organization ultimately accommodate to the new situation that Toyota was facing.

Our study contributes to the literature on supplier integration by presenting a conceptualization of Supplier Integration Capability (SIC) as a dynamic capability that is used by firms to cope with change through supply chain agility. We suggest that the sensing, seizing, and transforming sub-capabilities form a complementarity and are exploited simultaneously by firms who seek to develop SIC. This dynamic capability consists of routines embedded in the buyer-supplier relationships and facilitates the adaptation to environmental changes. Further, we provide an operationalization for SIC and test the model on a large data set. We analyze the relationship between SIC and operational and financial performance.

The paper is structured as follows. First, we will give an overview of the literature on inter-firm integration. We will first describe the concept and the current conceptualization of inter-firm integration in its broader context and will then define the scope of our research study: supplier integration. Next, we will describe the dynamic capability view of the strategic literature. This enables us to apply the concept to our research on supplier integration and to formulate our propositions and our research model. In the last part of our literature review, we will look at the link between integration and operational and business performance. Based on this literature, hypotheses will be formulated. Next, we will describe our research method and the testing of the hypotheses. At the end of the paper, implications of the results for both OM researchers and practitioners will be discussed and limitations and recommendations for further research will be provided.

## **5.2 Literature review and hypotheses**

### **5.2.1 Inter-firm integration as a resource**

Research on integration strongly suggests a positive relationship between integration and aspects of performance (Frohlich and Westbrook 2001, Rosenzweig et al. 2003, Kulp et al. 2004, Swink

et al. 2007). For a selection of published work on the link between inter-firm integration and performance, we refer to Appendix B.

Much of the prior literature has operationalized integration as a resource. For instance, Frohlich and Westbrook (2001) described the integration activities of a manufacturer with key suppliers and customers as a supply chain integration construct containing 8 items. Four items measured information exchange. The other four items concerned delivery frequencies, the use of customized packaging, logistical equipment, and 3rd-party logistics. Their study shows evidence that the widest arc of integration, i.e. the highest levels of integration with both suppliers and customers, has the strongest association with performance improvement. Rosenzweig et al. (2003) operationalized the integration intensity construct as a scale comprising both internal and external integration. Furthermore, Vickery et al. (2003) studied the link between information technologies and information sharing and confirmed that information technology is a core enabler of supply chain integration (Vickery et al. 2003). Kulp et al. (2004) conceptualized manufacturing-retailer integration and broadly classified the integration practices into two groups: information exchanges and collaborative planning resources. First, information exchanges encompass the sharing of information on demand, inventory levels at stores and retailers, and customer needs. These initiatives facilitate the transfer of relevant information between the parties. Second, collaboration planning revolves around the synchronization of manufacturer and retailer activities. Based on the analysis, the authors concluded that sharing inventory levels and planning collaboratively with suppliers are both associated with manufacturer performance. Similar to Kulp et al. (2004), Vereecke and Muylle (2006) measured integration as 2 distinct constructs: information sharing and structural integration. Their analyses suggested a weak link between information sharing and structural integration on the one hand and operational performance measures on the other hand for both supplier and customer integration. Wang and Wei (2007) analyzed the effect of system integration on flexibility. They measured integration as IT-enabled integration in a supply chain to support common operations and joint process planning and control. They found that integration creates information visibility and eventually increases flexibility. Finally, Swink et al. (2007) analyzed the individual effects of corporate strategy integration, product-process technology integration, strategic customer integration, and strategic supplier integration on the operational capabilities. They found that each integration type had unique benefits.

Despite differences in operationalization, most research has addressed inter-organizational integration as a set of operational or strategic resources focusing on better coordination of information and physical flows of products (see Appendix B). Common to these studies is the conceptualization of integration as a resource possessed by a firm that improves firm performance. However, this view does not examine how integration produces capabilities that can allow a firm to reconfigure its resources in dynamic environments.

### **5.2.2 Defining supplier integration**

Following Swink et al. (2007) and Carr and Pearson (1999), we define supplier integration as the processes or routines of acquiring and sharing information with a supplier, the practices and procedures in place to handle this information and the processes to install new supplier practices. Although integration itself does not have a single accepted definition or operationalization, Appendix B shows us that the various operationalizations of integration do share some common themes. The concept of supply chain integration spans information integration (e.g. Vickery et al. 2003), system integration (e.g. Wang and Wei 2007), and physical integration (e.g. Frohlich and Westbrook 2001). The literature also makes a distinction between intra-company and inter-company integration (e.g. Narasimhan and Kim 2002) and divides inter-company integration into the categories of supplier integration (e.g. Das et al. 2006) and customer or market integration (e.g. Kulp et al. 2004). This paper focuses on inter-firm integration with suppliers. These processes enable the supplier to deliver goods efficiently, i.e. in a cost-efficient and flexible way, and to react to changes (Swink et al. 2007, Carr and Pearson 1999). These integration practices consist of not only operational supplier integration activities aimed at sharing information, but also structural processes and strategic decisions including new supply chain initiatives to cope with changes and to create both cost efficiencies and process flexibility.

### **5.2.3 Towards a dynamic view of supplier integration**

The aim of this paper is to develop, explicate, and test the notion of Supplier Integration Capability (SIC). In the following paragraphs, we will first explain the nature of a dynamic capability and provide the theoretical foundation for the notion of Supplier Integration Capability.

The resource-based view of the firm (RBV) is a theoretical framework that seeks to understand how firms can achieve sustainable competitive advantages (Barney 1991, Penrose 1959, Peteraf 1993). RBV conceptualizes firms as bundles of heterogeneous resources that can create durable competitive advantages for the firm if these resources are valuable, rare, inimitable, and non-substitutable. Such resources will be difficult for other firms to imitate.

While RBV is valuable for its ability to identify what resources are important to a firm's success, the dynamic capabilities view attempts to identify capabilities that help to reapply the resources in multiple environments. The dynamic capability view finds its origin in the merging of the RBV of the firm and the Schumpeterian perspective (Schumpeter 1950). According to the Schumpeterian perspective, it is difficult to maintain sustainable competitive advantage in dynamic environments. To survive, firms constantly need to adapt to fit changing situations.

Dynamic capabilities that enable continuous redeploying of existing resources are what enable firms to be successful in these environments (Makadok 2001). The literature describes the difference between ordinary and dynamic capabilities (Winter 2003). Winter (2003) defines ordinary capabilities as those that permit a firm to 'make a living' in the short term. Dynamic capabilities, on the other hand, are those that operate to extend, modify, or create ordinary capabilities. Teece et al. (1997) define the concept of 'dynamic capabilities' as the firm's ability to integrate, build, and reconfigure both internal and external competencies to address rapidly changing environments.

Dynamic capabilities can be disaggregated into three distinct ordinary capabilities: (1) the sensing of opportunities and threats, (2) the seizing of opportunities, and (3) the maintenance of competitiveness through enhancing, combining, protecting, and transforming the business enterprise's intangible and tangible assets when necessary (Teece 2007). Researchers have argued that complementarities must be explicitly considered in strategy decisions (Milgrom and Roberts 2002). The capabilities identified by Teece (2007) exhibit a complementarity by working together to produce a dynamic capability. The simultaneous presence of these three capabilities is evidence of a dynamic capability.

## 5.2.4 Hypotheses

### 5.2.4.1 The Supplier Integration Capability construct

A dynamic capability, as described in the strategic literature, can be disaggregated into distinct sub-capabilities: (1) the ability to sense opportunities and threats, (2) the ability to seize opportunities, and (3) the ability to maintain competitiveness through enhancing, combining, protecting, and transforming the business enterprise's intangible and tangible assets when necessary (Teece 2007). The enterprise needs these sensing, seizing, and transforming capabilities reflected by specific integration practices to build and maintain sustainable competitive advantage in dynamic environments.

Based on this literature stream, we conceptualize and test Supplier Integration Capability (SIC) as a dynamic capability reflected by the simultaneous presence of sensing, seizing, and transforming processes. SIC differs from integration. While integration refers to a set of processes or practices, SIC is a special capability that can be created by implementing the right integration practices. The practices are different from the capabilities they enable.

The sensing capability is reflected by the presence of analytical systems to learn and to sense, filter, and calibrate to new opportunities (Teece 2007). In the context of supplier integration, these sensing capabilities are reflected by the integration practices that direct the physical flow between buyers and suppliers, based on different types of data and knowledge in the supply chain. The ability to sense opportunities requires access to supplier information, which creates the ability to recognize the need for new developments in the buyer-supplier relationship. Sensing is required for producing SIC because the firm requires information from the environment to determine when and how to react to change. Transformational capabilities are aimless without the ability to sense when change is needed.

Seizing capabilities are described by Teece (2007) as enterprise structures, procedures, designs, and incentives for taking hold of opportunities. Specifically, these capabilities help firms construct decision-making protocols, build loyalty and commitment, and control the environment. Typical practices in a supply chain context that pertain to seizing activities are vendor-managed-inventory (VMI) and collaborative planning, forecasting, and replenishment (CPFR). These practices represent investments that the firm makes with particular suppliers as

needed. Furthermore, these practices help firms understand future problems, assist in applying external knowledge to current planning decisions, and pro-actively manage threats and opportunities to physical flows. Seizing capabilities are required for producing SIC because a firm needs processes in place to be able to take advantage of whatever opportunities are sensed in the environment. Sensing and seizing thus work in tandem to allow the firm to determine when opportunities arise and then exploit the opportunities.

The third capability is transformation. Transforming reflects the continuous alignment and realignment of specific tangible and intangible assets (Teece 2007). Projects such as supplier development or additional investment in coordination systems may stimulate and continuously improve integration in the supply chain. These projects enable firms to learn from each other, co-specialize, and govern the supply chain better. In rapidly changing environments, there is value in the firm's ability to reconfigure its asset structure and to accomplish necessary internal and external transformations (Amit and Schoemaker 1993). This requires constant surveillance of markets and technologies and the willingness to adopt best practices. The transformation process reflects the dynamic nature of the SIC and represents the deployment of knowledge and resources, instead of just picking resources. Transformation capabilities are needed for SIC because they allow the firm to make lasting change to their own internal processes when needed. Though sensing and seizing capabilities are likely to be powerful together, transformation is needed to cope with long-term changes. It is the addition of the transformation capability that makes the combined meta-capability SIC a dynamic capability.

The three capabilities of sensing, seizing, and transforming produce a dynamic capability only when together, meaning that these three capabilities exhibit a complementarity. Prior studies have supported the view that there are complementarities among types of integration (Frohlich and Westbrook 2001, Rosenzweig et al. 2003). Swink et al. (2007) suggest that complementarities may arise from the sharing of resources needed to support integration efforts, from a more holistic and balanced view of the manufacturing task, and from the potential for knowledge gained from one dimension of integration to increase the usefulness of knowledge gained from another dimension of integration. It is not feasible to produce an exhaustive list of all the components of possible complementarities, but we can make a reasonable attempt at a literature-based identification about the nature of these practices. Although, some studies looked at the complementarities between supplier integration and customer integration (e.g. Swink et al.

2007, Frohlich and Westbrook 2002), internal and external integration (e.g. Swink et al. 2007), a theory of the complementarity among the different sub-competencies of integration has not yet been tested.

The complementarity among different types of integration is a result of the individual capabilities functioning as a continuous learning process. The buyer-supplier processes to smooth information and physical flows in the supply chain may create learning opportunities for the buyer and supplier. As such, a firm's knowledge consists not only of its own knowledge, but also of information from other actors in the network. Knowledge is also embedded within the procedures by which resources are gained and transactions and cooperation are conducted. To the extent that close integration with a supplier is required, long-term relationships embed future transactions within a learned and shared code. In dynamic environments, this learned and shared code is particularly valuable because it enables the organization and its supplier to quickly identify and act on shifts in what drives value (Rosenzweig et al. 2003). Eisenhardt and Martin (2000) describe the use of dynamic capabilities in both moderately and high-velocity dynamic markets. While dynamic capabilities are more detailed and are building on existing knowledge in moderately dynamic markets, they are rather simple and experiential in high-velocity markets. Important however is that dynamic capabilities are guided by learning mechanisms that help companies to cope with the (moderately or highly, and not stable) dynamic environment.

Consistent with the dynamic capability view, we propose that the level of Supplier Integration Capability a firm possesses is a function of the simultaneous presence of sensing, seizing, and transforming capabilities. Additionally, the complementarities view suggests that firms would tend to accumulate capabilities in combinations that would allow them to take advantage of certain complementarities. We thus model SIC as a higher-order latent factor, reflected by these integrative capabilities. Furthermore, we will compare this perspective with the dominant literature perspective that argues in favor of a direct-effect model in which specific types of integration serve as resources.

Venkatraman (1989) specifies distinct dimensions to measure fit. One approach is to model fit as co-variation (or co-alignment). According to this perspective, fit is a pattern of co-variation or internal consistency among a set of underlying theoretically related variables as would be the case with variables that exhibit complementarities. Fit as co-variation is similar to the concept of



a mega-strategy (Mintzberg 1979) or strategy as a pattern or stream of major and minor decisions (Grant and King 1982, Miles and Snow 1978). Our co-alignment model views Supplier Integration Capability as a higher-level construct reflected by the simultaneous, aligned presence of sensing, seizing, and transforming capabilities (Figure 5.1). This definition of fit is consistent with our suggestion that the simultaneous presence of each capability is necessary for the dynamic capability SIC to be present. As such, we will test the notion of Supplier Integration Capability as a dynamic capability by modeling it as a second-order construct:

**Proposition:** *Supplier Integration Capability (SIC) is a dynamic capability i.e. a multidimensional, second-order construct reflected by sensing, seizing and transforming capabilities.*

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Insert Figure 5.1 about here

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#### **5.2.4.2 SIC, Operational capabilities and Business performance**

According to the literature, Supplier Integration Capability should allow companies to break through the efficient frontier (Schmenner and Swink, 1998) and increase financial and market performance by improving operational performance. This is in contrast with previous research that was not always consistent in linking integration, operational, and financial performance. Carr and Pearson (1999) showed for instance that cooperative buyer-supplier relationships positively impact financial performance. Also Johnson (1999) demonstrated that strategic upstream integration results in enhanced firm performance in terms of sales, market share and growth. Both studies thus support a direct link from supply chain integration or from certain upstream or downstream elements of an integrated supply chain strategy to firm performance. Similarly, Frohlich and Westbrook (2001) show the direct influence of supply chain integration on different measures of performance, including operational capabilities and financial performance. Although the authors did find differences for all operational and financial performance measures, they did not find differences between low integrators and high integrators in terms of ROI. Rosenzweig et al. (2003) extended these findings by showing empirical evidence for the mediating role of operational capabilities in the link between integration and

business performance. Furthermore, Kulp et al. (2004) suggest that integration initiatives can impact profit margins both directly and indirectly via intermediate measures of performance. The authors find that information sharing appears to be a necessary practice to remain competitive (i.e. earn at least average profit margins), but not sufficient to earn supernormal profits. An overview of the results of these studies can be found in Appendix B. Overall, we can state that integration increases business performance. However, whether the relationship is direct or indirect, is still not clear from the current literature. One reason for this is that most of the studies employed correlations (e.g. Frohlich and Westbrook 2001, Vereecke and Muylle 2006). Studies that used more holistic models of integration by using structural equations modeling (SEM) did not always incorporate an analysis of both direct and indirect effects or suggested inconsistent links between integration and performance. Rosenzweig et al. (2003) found for instance that cost leadership is associated with sales growth, but not with customer satisfaction and that process flexibility is associated with customer satisfaction, but not with sales growth. These empirical findings are non-intuitive. Another example is Swink et al. (2007) who did not find significant associations between strategic supplier integration and flexibility, cost, and delivery. Additionally, they found a negative association between quality and strategic supplier integration. As such, these inconsistencies require further research into the link between integration and these operational capabilities.

Operational capabilities represent the manufacturer's actual or realized competitive strength relative to primary competitors (Rosenzweig et al. 2003). Cost and flexibility are arguably two of the most distinct dimensions of operational capabilities (Ward et al. 1998, Safizadeh et al. 2000, Boyer and Lewis 2002). They are associated with different structural and infrastructural choices (Skinner 1974, Kotha and Orne 1989, Safizadeh et al. 2000) and they correspond to different market strategies (Miller and Roth 1994). Fisher (1997) makes the same distinction between functional or cost-efficient supply chains and innovative supply chains. Narasimhan et al. (2008) recently suggested a similar classification. Based on canonical correlations and cluster analysis, the authors distinguish two subsets of SCM strategy typologies: strategies focusing on the variability of the supply chain and those focusing on the velocity of the supply chain. Velocity refers to the speed with which information and decision are transmitted across the supply chain and are highly correlated with financial performance. Variability refers to the ability of the

supply chain to respond to changing demands. Variability strategies, or what we will call process flexibility, are highly associated with customer satisfaction.

Swafford et al. (2006) also link the notion of flexibility to supply chain agility by describing flexibility as antecedents of supply chain agility. Consequently, Supplier Integration Capability can be linked to supplier flexibility and eventually supply chain agility, referring to the ability of the supply chain to adapt to environmental change and as such consistent with the notion of a dynamic capability.

**Hypothesis 1:** *SIC is positively related to Cost Efficiency (CE).*

**Hypothesis 2:** *SIC is positively related to Process Flexibility (PF).*

According to the dynamic capability view, supplier integration capability should help companies to maintain the ‘cost of running the system’ by adapting and smoothing the supplier integration processes. Cost efficiency (CE) enables manufacturers to be more price-responsible and to subsequently gain higher margins than competitors due to lower manufacturing costs (Hill 1994). Carr and Pearson (1999) found that, over time, buying and selling firms were able to develop relationships that involved increased communication, cooperation, and coordination of all activities associated with the production of goods and services, which helped both firms reducing their costs and eventually increase Financial Performance (FP).

**Hypothesis 3:** *Cost Efficiency (CE) is positively related to Financial Performance (FP).*

Kotha and Orne (1989) find that integration can help to develop flexible operations. Process flexibility (PF) is increasingly important in hypercompetitive environments, in which frequent changes in volume, product mix and schedules occur. Rosenzweig et al. (2003) contends that the development of process flexibility requires a great deal of closeness to supply chain entities. Consequently, Process flexibility is believed to create higher customer satisfaction in the supply chain and as such increases Market Performance (MP). We thus hypothesize:

**Hypothesis 4:** *Process Flexibility (PF) is positively related to Market Performance (MP).*

It is believed that increased market shares and sales volumes lead to higher financial returns for the firm. We thus hypothesize that Market Performance is positively linked to the Financial Performance of the firm.

**Hypothesis 5:** *Market Performance (MP) is positively related to Financial Performance (FP).*

## 5.3 Method

### 5.3.1 Sample

Since the possession of dynamic capabilities is especially relevant in moderately or high-velocity dynamic environments, we should be careful in selecting our sample. Furthermore, our selection should focus on best performing larger companies with international visibility (Teece, 2007). Based on these requirements, we used data from the 2005 round of the International Manufacturing Strategy Survey (IMSS) to test our proposition and hypotheses. The respondents of our sample for instance describe their business environment as moderately to highly dynamic (i.e. 3.20 (1.03 st.dev.) on a 5-point likert scale). The IMSS network was founded in 1992 to gather data about the practice and performance related to manufacturing and strategy in a global setting. The motivation behind the IMSS network is to create possibilities for comparative analyses of manufacturing strategies, and to analyze specific hypotheses within this context. A cross-sectional sample was thus used rather than a longitudinal study because we expect to see more variation across companies than changes within companies over time. The survey focuses on the ISIC Division 38: manufacture of fabricated metal products, machinery and equipment. The unit of analysis is the manufacturing plant. Furthermore, the sample is purposefully biased towards excellent, best practice firms within each country, indicating that the firms in the sample will be the most known, the best performing ones (e.g. on profit), the ones that have more international visibility, the ones that are more representative of the specificity and strengths of the country.

The questionnaire was completed by operations, manufacturing, and technical managers of the firm. In some cases, for instance for the medium-sized firms, the general manager answered the survey.

Dillman's (1978) total design method for mail survey research was followed and data from 711 firms were collected from 23 countries. Worldwide, 5787 firms were contacted by phone and asked to fill in the questionnaire. Prior to sending out the questionnaire, all countries, with the exception of Greece, first made phone calls to ask respondents whether they were willing to fill

in the questionnaire. This technique has been successfully applied in previous research and is known to increase response rates (Zhao et al. 2008). 4251 respondents agreed to participate in the research project and were sent a questionnaire. 760 answers were returned of which 711 were valid, after excluding the responses with too many missing variables. This resulted in a response rate of 18% (or 17%, if only the valid answers are taken into consideration) on the sent questionnaires. The response rate is much higher (i.e. 25% for the total answers and 23% for the valid answers) when Greece is omitted, which had a response rate of only 1%. If we calculate the response rates based on the initially contacted sample, these are 13% and respectively 16% after leaving out Greece. These response rates are acceptable, given that we are contacting managers in higher positions. For more details about the gathering process of the IMSS study, we refer to Voss and Blackmon (1998) and Silveira and Cagliano (2006).

Since integration is more complex in larger firms and since we want to preserve comparability, we excluded the smaller firms (i.e. with less than 50 employees) for our analysis. This resulted in a sample of 632 companies. Table 5.1 provides an overview of the demographic characteristics of the sample we examine.

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Insert Table 5.1 about here

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Since most countries started from an existing database with information on all the public companies in the country, this secondary data could easily be used to check for significant differences between respondents and non-respondents, as far as size, industry, sales, proprietary structure, etc. are concerned. When these databases were not available, non-respondents were directly contacted and asked questions for checking non-response bias, such as the existence of a formalized manufacturing strategy, manufacturing performance, strategic relevance of the manufacturing function, ongoing restructuring processes, etc. None of the countries reported problems of non-response bias.

### 5.3.2 Measures

We operationalize our constructs using multi-item reflective measures. The items for each construct are measured on five-point Likert scales (see Appendix A).

As described in the literature review, a dynamic capability is composed of three ordinary capabilities: (1) to sense opportunities and threats, (2) to seize opportunities, and (3) to maintain competitiveness through enhancing, combining, protecting, and reconfiguring the assets when necessary (Teece 2007). Each of these capabilities is reflected by the presence of specific integration practices.

Sensing routines are defined as analytical systems to learn and to sense, filter, shape, and calibrate opportunities (Teece 2007). In the context of supplier integration, these sensing capabilities are those processes to direct the physical flow between buyers and suppliers, based on different types of data and knowledge in the supply chain. Integration Sensing is thus reflected by the level of shared inventory knowledge, the level of shared production planning decisions and demand forecast knowledge and the level of order tracking/tracing.

Seizing routines are described by Teece (2007) as enterprise structures, procedures, designs, and incentives for taking hold of opportunities. These structured procedures help firms understand future problems, assist in applying external knowledge to current planning decisions, and proactively manage threats and opportunities to physical flows. The measure of Integration Seizing is reflected by the level of dedicated capacity, the level of requirement of supplier(s) to manage or hold inventories of materials at your site (e.g. VMI, Consignment stock), the use of CPFR and the level of physical integration of the supplier into the plant.

The last sub-capability is transformation. Transforming (or reconfiguring) reflects the continuous alignment and realignment of specific assets (Teece 2007). Projects such as supplier development or additional investment in coordination systems may stimulate and continuously improve integration in the supply chain. Integration transforming is measured by the degree of action programs undertaken over the last three years concerning supplier integration, such as rethinking and restructuring supply chain strategy and the organization and management of supplier portfolio through e.g. tiered networks, bundled outsourcing and supply base reduction, implementing supplier development and vendor rating programs and action programs to increase the level of coordination of planning decisions and flow of goods with suppliers including

dedicated investments (in e.g. extranet/EDI systems, dedicated capacity/tools/equipment, dedicated workforce, etc.).

Building on the supply chain integration construct, we define Supplier Integration Capability (SIC) as the firm's integration capacity, embedded in the use of integration sensing, integration seizing, and integration transforming processes. Complementarities among these three types of processes, as defined by the dynamic capability view, form the basis for stronger operating capabilities and improved business performance.

We also consider PF, CE, MP, and FP as latent multidimensional construct operationalized through multiple items. First, we measure two manufacturing capabilities in our study: cost efficiency (CE) and process flexibility (PF). These measures compare the cost efficiency and process flexibility of the company compared to its competitors. Consistent with prior research (e.g. Menor et al. 2007, Rosenzweig et al. 2003, Roth et al. 1992), we operationalize PF as a multidimensional construct consisting of mix flexibility, volume flexibility, and customization elements. CE is measured by the unit manufacturing cost, the procurement cost and the labor productivity. Second, business performance is measured by market performance (MP) and financial performance (FP). Similar to Menor et al. (2007) and Narasimhan and Kim (2002), MP is measured by market share and sales growth. FP is measured by return on sales (ROS) and return on investment (ROI).

For criterion-related validity, we correlated each of our perceptual business performance measures with the related objective measure in our survey (i.e. the actual amount of sales, market share, ROS and ROI). The correlation between our perceptual measures and objective measures was positive and significant ( $p < 0.05$ ), indicating that our perceptual measures are reliable. These results are similar to previous studies demonstrating statistically significant correlations between perceptual and objective performance measures (Dess and Robinson 1984, Vickery et al. 1997, Ward et al. 1994, 1998). Objective performance data are difficult to collect, since managers are often unwilling to provide them. The responses for these data ranged from  $N = 212$  (30%) to  $N = 263$  (37%) for our study for our performance measures. Only for ROI, we obtained a reasonable response rate of  $N = 544$  or 77%. Missing data as such, prevented us from using these less-perceptual metrics in further analysis.

Furthermore, we included control variables known or expected to affect the relationship with performance. Size of the firm was measured using the log of the total number of employees and was specified as a control to capture any effects of variations of firm size on relationship performance (Im and Rai 2008). Organization size is an important control variable in organizational studies, as larger organizations are likely to have more levels of management, more formalization and greater resources. Next to size, our analysis controlled for regional differences by looking at differences in the model for the different continents.

In the next section, we demonstrate the reliability and validity of our measures and test our model using structural equation modeling (SEM). Importantly for SEM, all items used in the analysis are univariate normal. Our analysis employs the maximum likelihood approach to missing values with the Fisher Information matrix to compute standard errors (Arbuckle 2005, Bollen 1989). Based on this method, only one case is reported as missing, resulting in a sample of 631. Descriptive statistics and bivariate correlations for all model variables are reported in Table 5.2.

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Insert Table 5.2 about here

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## 5.4 Results

The Structural Equation Modeling (SEM) approach enables us to describe the unique influences of each integration process, controlling for spurious associations. Furthermore, a structural model is a good approach to test for mediation.

The confirmatory factor analysis (CFA) and path models are tested using EQS software version 6.1 (Bentler 1992). A two-step approach based on the procedures outlined in Anderson and Gerbing (1988) is used. In the first step, the first-order measurement model is assessed to investigate the validity of the constructs. As suggested by Fornell and Larcker (1981), we first demonstrate the validity and reliability of our measurement model, before testing for relationships in the structural model.



### 5.4.1 Measurement model

We perform a confirmatory factor analysis (CFA) on all our first-order latent constructs to test our measurement model. CFA involves the estimation of an a priori measurement model, where the observed variables are mapped onto the latent constructs according to theory. Since we identified several integration practices relevant to describing a company's integration competence and selected measurement scales on the basis of previous studies, CFA is an appropriate technique for our analysis (Shah and Goldstein 2006).

The CFA results indicate that the data fit the measurement model well. We assess the overall model fit of the CFA using incremental, absolute, and parsimonious measures, since each provides a different perspective on how well the hypothesized relationships as estimated by the model, match the observed data (Hu and Bentler 1995). An overview of all the test statistics can be found in Table 5.4. Incremental fit measures, such as the CFI, NFI, IFI, GFI, and AGFI assess the incremental fit of the model compared to a null or worst-case model. The comparative fit index (CFI), the most commonly used incremental fit index, is 0.983 for our model. The root mean-square error of approximation (RMSEA), which is an absolute measure of fit assessing how well an a priori model reproduces the sample data, is 0.024 (with a 90% confidence interval of 0.015 – 0.032). Finally the parsimonious fit measures (normed Chi-square) assess the parsimony of the proposed model by evaluating the fit of the model relative to the number of estimated coefficients needed to achieve the level of fit (Bentler 1992, Bollen 1989). The normed Chi-square for this model is 1.53 (Hair et al. 1998).

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Insert Table 5.3 about here

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The reliability of the items and constructs comprising the measurement model are also examined. The squared correlations of the CFA path loadings (Appendix A) have scores above the 0.30 rule-of-thumb cut-off value, indicating adequate item reliability (Bagozzi 1981, Froehle and Roth 2004). Furthermore, the composite reliability and average variance extracted (AVE) statistics also indicate acceptable reliability levels for all constructs (Fornell and Larcker 1981). We assess the reliability of each first-order factor by computing composite reliabilities (Fornell

and Larcker 1981). Composite reliability is an aggregate measure of the degree of intercorrelation or internal consistency among measurement items of the same construct. The composite reliabilities, as calculated by the formula of Fornell and Larcker (1981), range between 0.67 and 0.91 (see Table 5.2). This is above the 0.60 threshold, indicating acceptable reliability levels for the constructs (Fornell and Larcker 1981, Bollen, 1989). The AVE statistics range between 0.40 and 0.84 (see Table 5.4). AVE statistics at the level of 0.40 are in most research seen as acceptable (Hatcher 2003).

The validity of our latent constructs is measured by looking at the unidimensionality, convergent validity, discriminant validity, and criterion validity of the constructs. Consistent with Anderson and Gerbing (1988), we utilize the CFA results to test the unidimensionality of the latent constructs. All path loadings are significant and above 0.50 (Appendix A), suggesting that all items are associated with their latent construct. Furthermore, the measurement model shows good overall fit. Since both are in place, we can conclude that the constructs exhibit unidimensionality.

Anderson and Gerbing (1988) note that if all manifest variables load significantly on their respective latent variables, convergent validity is supported. The path loadings and corresponding errors meet this criterion for all first-order factors (see Appendix A). The second-order factor will be measured in our structural model, as described in the next section.

Discriminant validity of the scales is also established using the CFA. Discriminant validity refers to the degree to which measures of different latent variables are unique and distinct from each other. We formed all possible pairs of latent constructs and tested each pair by first allowing each pair to freely correlate and by second setting the correlation between the two constructs to 1.00. The  $\chi^2$  differences between these unconstrained and constrained models are all statistically significant ( $p < 0.01$ ). Based on these tests, we can conclude that our constructs represent distinct scales (O'Leary-Kelly and Vokurka 1998). A second test for discriminant validity is to check whether the AVE of each pair of factors is greater than their squared correlation. All constructs also passed this test.

## 5.4.2 Structural model

In order to test the hypotheses, we first analyze the fit of the sample data to the proposed co-alignment model using structural equation modeling (SEM). The overall fit indices indicate that the co-alignment model, as provided by Figure 5.2, fits the data fairly well ( $\chi^2 = 310.601$ ,  $df = 161$ ,  $p\text{-value} = 0.00$ ,  $CFI = 0.962$ ,  $GFI = 0.958$ ,  $AGFI = 0.945$ ,  $RMSEA = 0.034$  (with a 90% confidence interval from 0.027 to 0.041)) (see Table 5.4). Integration competence is positively linked to the three first-order constructs: Sensing ( $\gamma = 0.77$ ,  $p < 0.01$ ), Seizing ( $\gamma = 0.82$ ,  $p < 0.01$ ) and Transforming ( $\gamma = 0.57$ ,  $p < 0.01$ ). This provides initial support for the presence of Supplier Integration Capability (SIC).

Additionally, the results support both hypotheses 1 and 3 which relate SIC to Process Flexibility (PF) ( $\gamma = 0.38$ ,  $p < 0.01$ ) and to Cost Efficiency (CE) ( $\gamma = 0.42$ ,  $p < 0.01$ ), suggesting that integration competence is strongly, directly related to each of these capabilities. Each of these capabilities in turn are significantly related to a business performance outcome. PF is positively related to market performance (MP) ( $\gamma = 0.21$ ,  $p < 0.01$ ), supporting hypothesis 4. CE is positively related to financial performance (FP) ( $\gamma = 0.17$ ,  $p < 0.01$ ), supporting hypothesis 2. Finally, MP is strongly related to FP ( $\gamma = 0.41$ ,  $p < 0.01$ ), supporting the final hypothesis 5.

An additional question of interest is whether there is a significant relationship between SIC and business performance. Additional analyses are required to test this relationship, which is mediated both through PF and through CE. As described by Baron and Kenny (1986), a variable may be characterized as a mediator to the extent that it accounts for the relation between the predictor and the criterion. To analyze this mediation effect, we decomposed the co-alignment model into direct effects, indirect effects and total effects. As such, we added two direct paths to the co-alignment model: one path linking SIC directly to Market performance (MP) and one linking SIC to Financial Performance (FP). The direct effects of SIC on MP ( $\gamma = 0.09$ ,  $p < 0.05$ ) was significant at  $p < 0.05$ , but not at the 0.01 level, and the direct effect of SIC on PF ( $\gamma = 0.05$ , n.s.) was not statistically significant, while the indirect effects as presented in Figure 5.2 were significant, indicating that PF is a partial mediator and CE a full mediator in the relation between SIC and business performance. We elaborate on these mediation results in the discussion section.

To examine the proposed co-alignment model (Venkatraman 1989), we compare the model with a direct-effect model in which the three first-order competences are posited to be directly related to PF and CE. To set up this model, we remove the second-order latent construct (i.e. the meta-competence construct) from Figure 5.1. Paths are created from each of the 3 first-order integration types to the two competitive capabilities PF and CI. All other paths are similar as in Figure 5.2. This direct-effect model can be found in Appendix C. As proposed by Bollen (1989), we compare the models by using overall fit statistics to judge the general adequacy of each model. We use component fit statistics to judge the adequacy of individual aspects of a particular model. Finally, we use rules of parsimony to make the final model selection. The resulting overall fit statistics for the direct-effect model are reasonable, but generally inferior to those of the second-order model ( $\chi^2 = 389.86$ ,  $df = 160$ ,  $p\text{-value} = 0.00$ ,  $CFI = 0.938$ ,  $GFI = 0.948$ ,  $AGFI = 0.932$ ,  $RMSEA = 0.044$  (with confidence interval 0.038 to 0.050)) (see Table 5.4). The chi-square test of the co-alignment model shows better fit with the data than the direct-effect model. Furthermore, the direct-effect model, as presented in Appendix C, does not show significant direct effects for integration sensing on PF ( $\gamma = -0.03$ , n.s.) and CE ( $\gamma = -0.10$ , n.s.), which is inconsistent with what is posited in the literature. Based on these results, we could conclude that complementarities among the integration dimensions are important to detecting the importance of each integration type. Finally, the second-order model is more parsimonious than the first-order model since it requires the estimation of one fewer path. Given the better overall better fit statistics and the logic of parsimony, which prefers model with fewer estimated paths (Anderson and Gerbing 1988, Hull et al. 1995), the second-order factor model (Figure 5.2) constitutes the preferred solution.

### 5.4.3 Additional analyses

As with all studies in which data is collected from a single source, common method variance may be a concern. Two tests were conducted to determine the extent to which method variance is a threat to validity. First, a Harmon one-factor test was conducted (Podsakoff and Organ 1986). While the model with seven factors was highly significant showed good fit ( $NFI=0.978$ ;  $CFI=0.983$ ,  $RMSEA=0.024$ ), the model with a single factor showed poor fit ( $NFI=0.524$ ;  $CFI=0.549$ ,  $RMSEA=0.115$ ). Results from this test suggested the presence of seven different factors indicating that common method effects are not a likely contaminant of the results

observed in this data analysis. However, Podsakoff et al. (2003) have critiqued this test as insensitive since “common method variance would have to completely account for the covariances among the items for it to be regarded as a problem in a particular study.” To further investigate common method variance, an additional test was performed following the procedure recommended by Widaman (1985) and Podsakoff et al. (2003). This method showed that while the method factor did improve model fit slightly ( $\chi^2(20) = 69.89, p < .01$ ), it accounted for only a small portion of variance. Specifically, 8.47% of the variance was accounted for by the method factor, which is less than the average amount of method variance (25%) observed by Williams et al. (1989). Furthermore, all factor loadings of the traits were still significant in the CFA model after including the common method factor. These results suggest that factors other than common method variance are the likely source of the variance found in the present data.

We also tested our model for differences between cultures. The analysis showed that the model did not differ according to culture. More information can be found in Appendix D.

## **5.5 Discussion**

The primary contribution of this paper is defining and testing the notion of Supplier Integration Capability (SIC) as a dynamic capability. Our analysis shows support for this dynamic view in which firms take advantage of complementarities among the sub-capabilities of SIC to react to changes in a cost-efficient, agile way.

As described by the literature, the dynamic view can be contrasted with the RBV, which directly ties the resources that a firm collects rents from to performance. In modern, dynamic environments, the usefulness of a specific resource can be invalidated quickly, making it difficult for firms to collect long term rents. SIC allows the organization to deal with these environmental changes by sensing environmental changes, seizing opportunities, and transforming their organizations and supply chain structures to match the environment. In other words, developing SIC allows the organization to react to environmental pressures and opportunities so that it can renew its competitive advantage in multiple environmental situations. This requires a perspective of the organization and of resources that recognizes the importance of organizational learning and continuous capability-building or redeploying existing resources.

This study is the first large-scale empirical effort to investigate and measure supplier integration as a dynamic capability and has implications for theory on (i) supply chain agility, (ii) supplier integration management, and (iii) the use of dynamic capabilities in the OM literature. We will discuss these implications in the next paragraphs.

### **5.5.1 SIC as a creator of supply chain agility**

Based on the literature review, a generic interpretation of organizational agility is the capability of an organization to adapt or react to marketplace changes or to seize and exploit market opportunities. Kidd (2000) adds that organizational agility is founded on processes and structures that facilitate speed and adaptation. While processing agility over a firm's extended supply chain is desirable, a firm has less control over its external processes than over its own. Also, from a practical viewpoint, it would be impossible, to investigate the agility of every process in an organization's extended supply chain. By focusing on supplier integration, we have sought to keep this study tractable, while gaining an understanding of one of the antecedents of a firm's supply chain agility that is within the firm's domain of control. Based on our analysis and on the work of Swafford et al. (2007), we could confirm that Supplier Integration Capability, seen as a dynamic capability, plays an important role and is an antecedent in creating an agile supply chain.

### **5.5.2 SIC as a tool to manage suppliers and increase performance**

Our data shows that SIC should be considered a higher order competence, reflected by sensing, seizing, and transforming processes. These different sub-competences require a variety of skills to implement. It is not by adopting a single process that a company creates a Supplier Integration Capability, but instead by implementing different processes with the involvement of different people and skills. As proposed in previous studies, implementing a wider range of supply chain integration elements is better than implementing only a few (Swink et al. 2007; Frohlich and Westbrook 2001; Rosenzweig et al. 2003). However, a theory of complementarities among these different sub-competencies of supplier integration had not been tested yet. This study identifies one set of complementarities derived from the dynamic capabilities literature.

Part of the confusion in prior results stems from the fact that without conceptualizing a single dynamic capability based on responsiveness to environmental changes, prior researchers were

looking at relationships between individual types of integration and performance, which may not have a significant effect individually. Furthermore, environmental changes may quickly invalidate the usefulness of an individual practice or routine. Our analyses show that the dynamic capability model fits better than the direct effect model as described in previous research on supply chain integration. It also explains why some previous models found weak or insignificant links between a specific type of integration and business performance. By identifying the components of SIC, we are able to provide an explanation for these sometimes inconsistent results.

Rosenzweig et al. (2003) found two partial mediation models - one for percentage of revenue from new products and one for ROA - and two full mediating models - one for customer satisfaction and one for sales growth. This implied that no direct effects exist between integration intensity and performance. Consequently, it appeared that the benefits of integration should first be translated into operational capabilities, such as product quality, delivery reliability, process flexibility, or cost efficiency. Swink et al. (2007) only found quality (but not cost efficiency, delivery, process, or new product flexibility) to be a mediator between strategic supplier integration and market performance and customer satisfaction. One possible explanation for this might be that supplier integration was only measured at the strategic level, whereas our study measures both operational and strategic items of integration. As such, our results show that cost efficiency and process flexibility both are mediators in the link between supplier integration capability and business performance.

### **5.5.3 Theory development on dynamic capabilities**

Another contribution of this research is to put forth SIC as a dynamic capability. By bringing in the notion of dynamic capabilities in the OM literature, based on the foundations as defined by Teece (2007), we conceptualized the dynamic nature of supplier integration. The empirical results of this study show that Supplier Integration Capability, reflected by sensing, seizing, and transforming routines, indeed form distinct and internally consistent bundles and are significantly related to performance.

These sub-capabilities show up repeatedly in prior dynamic capabilities work. Zahra and George (2002) for instance describe absorptive capacity as a dynamic capability consisting of four dimensions (acquisition, assimilation, transformation and exploitation). They explain how these

dimensions build upon each other to make absorptive capacity a coherent dynamic capability that fosters organizational change and evolution across environments. They make the distinction between potential, which is about acquiring and seeing knowledge in the environment, and realized capabilities, which is about exploiting this knowledge. Tu et al. (2006) showed that absorptive capacity enhances time-based manufacturing practices. In addition, Teece (2007) describes innovation as a dynamic capability and discusses the foundations of a dynamic capability as sensing, seizing and transforming. This framework recognizes that innovation, which concerns product or process innovation/flexibility, has a major impact on competition. Finally, Helfat et al. (2007) suggest that relationship capability as discussed by Dyer and Singh (1998) can also be viewed as a dynamic capability, which purposefully creates, extends or modifies the firm's resource base, augmented to include the resources of its alliance partner. Researchers (Doz and Shuen 1990, Mody 1993) have pointed out that collaborations and partnerships can be a vehicle for new organizational learning, helping firms recognize dysfunctional routines and prevent strategic blind spots (Teece et al. 1997). The acquisition and diffusion of inter-organizational knowledge through routines may assist in the collection of new information that can provide the diversity needed to start the buildup of new knowledge (Zollo and Winter 1999). By replicating routines in diverse contexts and accumulating experience with the new approach, organizations can simultaneously achieve a number of objectives. On the one hand, they complete the adaptation process, and on the other hand they may renew the set of procedures by generating new information from applying the routines in diverse contexts. The learning as such happens in a semi-automatic fashion on the basis of the individual adaptations of the routines to unsatisfactory performance or to changes. These adaptation processes, which represent the dynamic nature, are described by Teece (2007) as transforming processes.

Within the operations management field, this work adds to that of Peng et al. (2007) who established a conceptual link between routines and operations capabilities for improvement and innovation using dynamic capabilities theory.

#### **5.5.4 Managerial implications**

Firms strive to develop and sustain competitive advantages. In an increasingly dynamic environment, firms need to be able to adapt quickly to sustain competitive advantages. Our study shows that supply chain agility through more supplier integration can create this ability to adapt



processes in a cost efficient way. Supplier integration is an important competence to create this supply chain agility, but practices cannot be added randomly or according to whatever direct effects are obvious in the short term. Forward-looking managers who are willing to invest in skills and practices for supplier integration can take advantage of complementarities by developing Supplier Integration Capability.

Supplier Integration Capability requires different capabilities, which we refer to as sensing, seizing, and transforming. First, managers have to create a climate of trust in which information can be shared among buyers and suppliers. Previous research showed that successful firms share more information with their partner than unsuccessful firms. Buyers and supplier should share information about forecasts, planning, capacity, strategic plans, new products, production, and shipping (i.e. sensing). This information may help the buyer to plan its own operations and to pro-actively sense possible short-and long-term supply disruptions. Continuously updating and upgrading information and knowledge is important in a dynamic environment. Buyers need to understand the environment, the situation of key suppliers and the possible short-and long-term delivery process and product and process problems. As such, more important than static knowledge is the ability of the buyer to quickly grasp and apply knowledge that they need to solve a problem or to improve a system or process. Analyzing this information or knowledge can be standardized with the help of some systems or procedures such as VMI, CPFR, dedicating capacity, etc (i.e. seizing). A first type of learning occurs while pursuing these processes and adapting these processes to a new situation or to improve. We call this ‘learning-by-doing’. A second type of learning, which we measured in this study as integration transforming, occurs through the implementation of new action plans and projects concerning supplier integration. These action plans can consist for instance of new systems to share or process information, new evaluation systems to assess the relationship or new ways of working together. These learning processes are indispensable in a dynamic environment in which processes have to adapt smoothly and easily.

### **5.5.5 Limitations and future research**

Our research has several limitations, providing opportunities for future research. A first limitation is that our study is part of a large-scale data collection. The advantage of this database is that it increases the statistical power or the probability to reject a false null hypothesis, while

the disadvantage may be that the measurement instruments may not be optimal. For instance, while we have identified a set of routines related to supplier integration, there are other integration routines that could contribute to the improvement of the buying firms, which are not included in our analysis. However, this should not create difficulties in measuring supplier integration capability since our measures are reflective. Nevertheless, future research may include other supplier integration practices reflecting the sensing, seizing, and transforming processes. Second, we measured supplier integration capability and its impact on performance as seen from the buyer's perspective. We did not include the supplier's perspective. Future research can address this shortcoming by collecting dyadic data. Another extension of the research is to look into contingencies in the framework. Manufacturing strategy, market conditions and internationalization are some examples of contingencies that should be tested in the future. Finally, we investigated a dynamic capability by using cross-sectional data. This data does not enable us to fully capture the dynamic nature of supplier integration because of the 'snap-shot' nature of the data. Future research could verify that firms with SIC sustain their performance across environments. However, we set a first step towards capturing the dynamic nature by using the foundations of Teece (2007) for dynamic capabilities, in which integration transforming measures the evolution or dynamic nature of supplier integration.

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## Tables and Figures

Table 5.1: Sample characteristics

Demographic dimension	N	Percentage (%)
<i>Personnel employed</i>		
50 - 100	115	18.2
101 - 250	217	34.3
251 - 500	136	21.6
501 - 1000	85	13.4
> 1000	79	12.5
Total	632	100.0
<i>Industrial sector (within ISIC code 38)</i>		
Fabricated metal products, except machinery and equipment	233	36.9
Machinery and equipment not elsewhere classified	127	20.1
Office, accounting and computing machinery	16	2.5
Electrical machinery and apparatus not elsewhere classified	84	13.3
Radio, television and communication equipment and apparatus	37	5.9
Medical, precision and optical instruments, watches and clocks	24	3.8
Motor vehicles, trailers and semi-trailers	64	10.1
Other transport equipment	39	6.2
No response	8	1.3
Total	632	100
<i>Continents</i>		
Western Europe	310	49.1
Eastern Europe	118	18.7
Northern America	59	9.3
Southern America	81	12.8
Others	64	10.1
Total	632	100

Table 5.2: Descriptive statistics and bivariate correlations

Variable	Mean	Std. dev.	$\eta_1$	$\eta_2$	$\eta_3$	$\eta_4$	$\eta_5$	$\eta_6$	$\eta_7$
$\eta_1$	3.19	0.88	1						
$\eta_2$	2.45	0.82	0.49**	1					
$\eta_3$	3.30	0.84	0.32**	0.33**	1				
$\eta_4$	2.99	0.69	0.17**	0.21**	0.17**	1			
$\eta_5$	2.78	0.64	0.16**	0.23**	0.18**	0.40**	1		
$\eta_6$	3.27	0.84	-0.03	0.10*	0.07	0.08	0.17**	1	
$\eta_7$	3.41	0.79	0.05	0.07	0.12*	0.15**	0.09*	0.38**	1

\*  $p < 0.05$ , \*\*  $p < 0.01$ .

Table 5.3: Overall fit indices

Fit indices:	CFA	Co-alignment Model	Direct-effect Model
Chi-square	227.23	310.60	389.86
d.f.	149	161	160
Normed Chi-square	1.53	1.93	2.44
RMSEA	0.024	0.034	0.044
CFI	0.983	0.962	0.938
NFI	0.978	0.916	0.893
IFI	0.983	0.963	0.939
GFI	0.969	0.958	0.948
AGFI	0.956	0.945	0.932

Figure 5.1: Supplier Integration Capability model

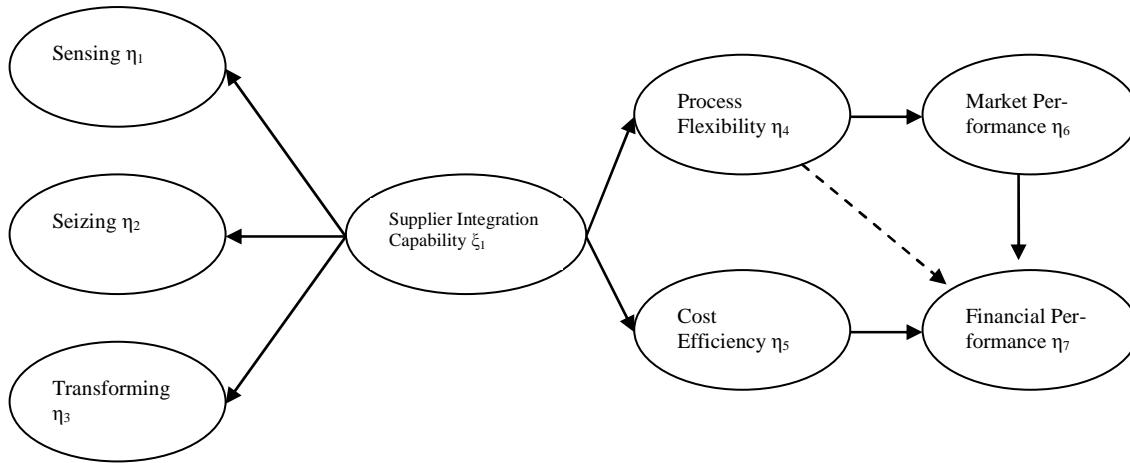
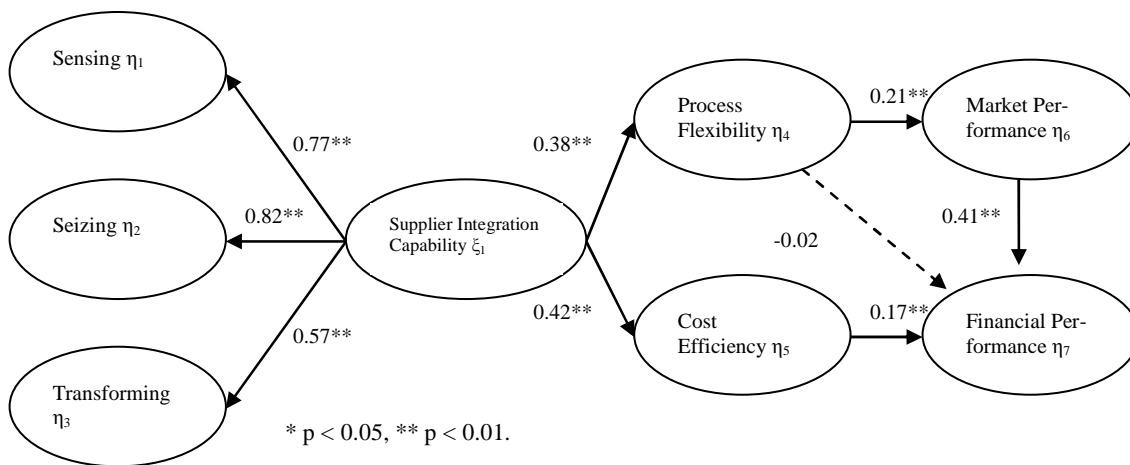


Figure 5.2: Supplier Integration Competence structural model



# Appendices

## Appendix A: Confirmatory Factor Analysis

Construct	Standardized path loading*	AVE	construct reliability
How do you coordinate planning decisions and flow of goods with your key/strategic suppliers? (Scales 1-5: Level of Adoption: (1) none, (5) high)			
Integration sensing ( $\eta_1$ )		0.40	0.67
x <sub>1</sub> Share inventory level knowledge	0.72		
x <sub>2</sub> Share production planning decisions and demand forecast knowledge	0.63		
x <sub>3</sub> Order tracking/tracing	0.54		
Integration seizing ( $\eta_2$ )			
x <sub>4</sub> Dedicated capacity	0.57	0.43	0.72
x <sub>5</sub> Require supplier(s) to manage or hold inventories of materials at your site (e.g. VMI, Consignment stock)	0.71		
x <sub>6</sub> Collaborative planning, forecasting and replenishment (CPFR)	0.68		
x <sub>7</sub> Physical integration of the supplier into the plant	0.55		
Indicate degree of the following action programmes undertaken over the last three years. (Scales 1-5: (1) none, (5) high)			
Integration transforming ( $\eta_3$ )		0.48	0.73
x <sub>9</sub> Rethinking and restructuring supply chain strategy and the organization and management of supplier portfolio thorough e.g. tiered networks, bundled out-sourcing and supply base reduction	0.69		
x <sub>10</sub> Implementing supplier development and vendor rating programs	0.69		
x <sub>11</sub> Increasing the level of coordination of planning decisions and flow of goods with suppliers including dedicated investments (in e.g. extranet/EDI systems, dedicated capability/tools/equipment, dedicated workforce, etc.)	0.68		
How does your current performance compare with main competitor(s)? (Scales 1-5: (1) much worse, (3) equal, (5) much better)			
Flexibility ( $\eta_4$ )		0.45	0.75
y <sub>1</sub> Mix flexibility	0.55		
y <sub>2</sub> Volume flexibility	0.77		
y <sub>3</sub> Product customization ability	0.80		
Cost efficiency ( $\eta_5$ )			
y <sub>4</sub> Manufacturing costs	0.57	0.49	0.72
y <sub>5</sub> Procurement costs	0.75		
y <sub>6</sub> Labour productivity	0.77		
What is the current business unit performance? For market share indicate average in market(s) served by business unit products. How do you perform relative to main competitor(s)? (Scales 1-5: (1) much worse, (3) equal, (5) much better)			
Market performance ( $\eta_6$ )		0.67	0.80
y <sub>7</sub> Sales	0.85		
y <sub>8</sub> Market Share	0.78		
Financial performance ( $\eta_7$ )			
y <sub>9</sub> Return on Sales (ROS)	0.95	0.84	0.91
y <sub>10</sub> Return on Investment (ROI)	0.88		

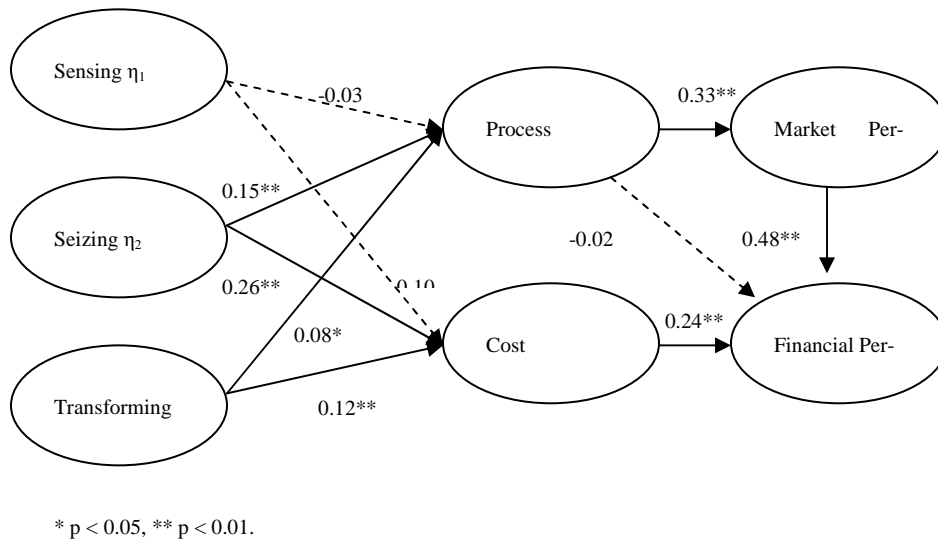
\* All of the path loadings are significant at the 0.01 level.

## Appendix B: Literature review table

**Table 1: Overview of research on inter-organizational integration**

Authors	Definition of integration	Integration measures	Performance measures	
<b>Carr and Pearson (1999)</b>	Buyer-supplier relationships are an investment by the buying firm in the supplier that may reduce transaction costs and yield a more cooperative relationship.	Measure of whether buyers enter into agreements leading to improved performance and influential power. information sharing and planning, system integration	Financial performance	Direct positive effect
<b>Johnson (1999)</b>	Strategic integration is a progressive involvement between two firms that implies combined resources, expanded capabilities and enhanced competitive positions of the firms involved.	importance of the relationship; long-term strategy with the supplier; strong cooperation	Financial performance	Direct positive effect
<b>Frohlich and Westbrook (2001)</b>	Supply chain integration contains two interrelated forms of integration: the forward physical flow and the backward information integration	Measures the degree and the direction of integration of measures of information and structural integration.	Marketplace competitive advantage, productivity increases, non-productivity benefits based on changes in BU performance.	Direct positive effect
<b>Rozenzweig, Roth and Dean (2003)</b>	Integration intensity reflects the relative external integration that is an expression of a firm's cross-business	How integrated is your business internally and externally?	Business performance Competitive capabilities as mediators	Direct and indirect positive effect
<b>Vickery, Jayaram, Droge and Calantone (2003)</b>	An integrative supply chain strategy recognizes that integrated business processes create value for the firm's customers and go beyond the boundaries of the firm.	Integrative information technologies Supply chain integration	Financial performance Customer service as mediator	Indirect positive effect
<b>Kulp, Lee and Ofek (2004)</b>	Customer integration contains information exchange (on demand, inventory level and customer needs) and synchronizing of planning	Information exchanges; collaborative planning resources	Profit margin	Direct and indirect positive effect
<b>Verecke and Muyille (2006)</b>	buyer-supplier relationships that embrace both conflict and partnership, implying some form of mutuality without an apparent need for lifetime commitment or total openness and trust.	Information sharing and structural integration	Operational performance	Direct positive effect
<b>Wang and Wei (2007)</b>	Virtual integration is the extent to which trading partners use IT to facilitate common operations between supply chain partners.	System integration	Flexibility Information visibility as mediator	Partial mediation
<b>Das, Narasimhan and Talluri (2006)</b>	Supplier integration is a state of syncretism among the supplier, purchasing and manufacturing constituents of an organization.	System integration, Relational capital resources	Manufacturing performance Financial performance	Non-linear effect
<b>Swink, Narasimhan and Wang (2007)</b>	Strategic integration consist of information and knowledge sharing with four sources external to the plant: corporate strategy, product-process technology, suppliers and customers	Information and knowledge sharing	Business performance: market performance and customer satisfaction Manufacturing capabilities as mediators	Direct and indirect positive effect

### Appendix C: Direct-effect model



### Appendix D: Cultural differences

Since our data contains respondents from multiple countries, we have to control for cultural effects. In order to do so, we split our data in four different groups based on the 4 main continents that are represented in our database: Northern America, Southern America, Western Europe and Eastern Europe. We did not include China, Israel, Australia and New Zealand in our comparison model, since the data for these countries were limited. To test whether there are differences across the continents, we should determine whether the general structure of the hypothesized model differs across the 4 continents (Jöreskog and Sörbom 1999). The hypotheses are most appropriately examined via multi-sample analysis (where the parameters are constrained to be the same across groups). The chi-square statistic was 1042.58 (df = 708) when the parameters were constrained to be the same across groups. The chi-square was 1006.704 (df = 684) when the parameter estimates were allowed to vary freely across groups. In Anderson and Gerbing's chi-square difference (1988) test, the chi-square of the unconstrained mode was not significantly ( $p < 0.05$ ) lower than that of the constrained model ( $\Delta\chi^2 = 35.88$ ,  $\Delta df = 24$ ), suggesting there are no differences at the  $p > 0.05$  level in the modelled relationships across the four continents. This is also confirmed by the Lagrange Multiplier (LM test) that indicates that

the individual constrains should not be released. Furthermore, the indices for the constrained model indicate that the data fit the different continents reasonably well. The comparative fit index (CFI) is 0.958, the root mean-square error of approximation (RMSEA) is 0.035 with a 90% confidence interval of 0.023 to 0.044 and a normed Chi-square of 1.47 (Hair et al. 1995). In summary, we could conclude that there are no significant differences between the continents.

# Chapter 6: From traditional buy-sell relationships to supplier alliances: Towards a dynamic life-cycle theory

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This study focuses on supplier alliance trajectories and the triggers for starting up new integration activities. Both literature and case study data are used to explore the development of supplier alliances, to identify factors influencing it, and to propose effective management practices. Our data suggest three important integration activities in supplier alliances: operational, relational and financial integration. Each of these are triggered and stimulated through different managerial decisions such as supplier reduction programs, process improvement programs and/or risk management programs. Furthermore, our study adds to the development of a life cycle theory of supplier alliances.

Keywords: supplier alliances trajectories, integration, life-cycle theory

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## 6.1 Introduction

A significant body of literature examines the benefits of interorganizational alliances (e.g. Swink et al. 2007, Vereecke and Muylle 2006, Frochlich and Westbrook 2001, Monzeka et al. 1998), yet there has been little research on the development of these alliances over time (Arino and de la Torr  1998). An interesting research study in this respect by Narayandas and Rangan (2004) describes three buyer-seller relationships in mature markets. This study analyzes how alliances with different starting-points concerning power evolution over time in terms of trust and commitment. Another recent study in the agricultural chemical industry documented the evolution of the relationship properties of such interorganizational alliances (Jap and Anderson 2007). This study measured the relationship properties at two points in time and confirmed the gradual increase of these relationship properties. However, these studies did not look at the development of supply chain integration practices and the triggers for moving these alliances from one phase to the next (Jap and Anderson 2007). Furthermore, they did not investigate the



governance and organizational factors influencing the evolution of alliances. Our research fills this gap by collecting data on the development of these alliances and by asking managers about their motivations for moving this alliance towards a highly integrative alliance.

In general, we could state that this study is motivated by several research questions: (1) What theories describe how supplier alliances develop? (2) What factors motivate alliances to evolve towards more integration? (3) How do firms evolve towards higher levels of supplier integration (i.e. the link between pre- and post-integration phase)? and (4) How are these strategic alliances managed?

The literature represents two theoretical frameworks of alliance development (Jap and Anderson 2007). Each of these theories has considerably impacted research on strategic alliances. The first framework is developed by Dwyer et al. (1987). They described a buyer-supplier relationship as passing through a fairly rigid sequence of stages. Furthermore, they described the behavioural properties of this relationship in each stage. Ring and Van de Ven (1994) on the other hand, proposed a more general theory of interorganizational relationships. They described this as a cyclical process in which each step is repeated in each cycle. Although there are a lot of similarities between both theories, there are some differences in explaining some of the ‘why’ and ‘how’ questions of these interorganizational developments. A first aim of this paper is thus, based on the existing models, to better understand the life cycle theory of interorganizational alliances and triggers for moving from one phase to the other.

There exist at least two particular decision moments for strategic alliances: 1) the decision to start up a transactional relationship and 2) the decision to move towards a strategic alliance. Previous studies have remained relatively silent on the link between these two decision points (i.e. the pre-integration phase) as well as the development over time after the decision of creating integrative processes (i.e. the integration phase). In this paper, we want to understand how the pre-alliance phase affects the alliance phase in terms of behavioural characteristics and governance. Previous research (see chapter 4) described contingencies in strategic alliances according to the relational characteristics (i.e. trust and interdependence) and the use of structured integration practices. However, it is not clear whether these different types of strategic alliances are the result of measuring strategic alliances at different development stages (where one stage is the pre-integration stage while the other one the integration phase) or whether these

are really different types of strategic alliances, which can be explained by contingencies. A second aim of this paper is thus to understand the link between the pre-integration and the integration phase.

Towards this end, we conducted case study research of 5 supplier alliance trajectories. We collected retrospective data from both people on the supplier and buyer side of the alliance. Since constructing a theory of alliance development is a difficult undertaking over a long period of time and since we want to answer questions that explain the 'how' and 'why', we believe that rich data is the most appropriate way to address this gap.

The paper begins with a literature review of life-cycle theory on strategic alliances. Second, we describe the applied case study methodology, including company selection, data gathering protocols and analytical techniques. Third, we analyze the cases from a within and between case perspective. This leads to theoretical propositions and explanations in the discussion part. The paper then finally concludes with a discussion of the limitations and future opportunities.

## **6.2 Supplier alliance trajectories**

Supplier alliances are defined in the literature as long-term cooperative relationships designed to increase the operational performance of the buyer and supplier firm. Some of the main benefits of this type of relationships are the increase in the synchronization of the supply chain, the reduction of the total costs, the improvement of quality and cycle time, as well as a strong competitive position which exceeds any possible contribution from traditional relationships (Monczka et al. 1998).

The literature describes supplier alliances as being different from traditional buy-sell contractual arrangements in the following three necessary and sufficient conditions: (1) interdependence of the parties, (2) shared benefits among the parties and (3) ongoing participation in one or more key strategic areas such as technology, products or markets (Yoshino and Ranger 2005). Since the turning point of transitioning from a traditional buy-sell relationship to a supplier alliance is rather vague and unclear in the literature, we describe this turning point in our research as the point in time at which a party does a partner-specific investment in terms of an operational (i.e. production and/or logistics) investment. As such, before the investment in a partner-specific asset

is made (see definition below), we talk about the pre-integration phase, versus the integration phase after the main investment.

Narayandas and Rangan (2004) described the evolution of three industrial buyer-seller relationships in mature industrial markets. These relationships started with different degrees of asymmetry in power and evolved differently over time. Their research suggests that asymmetric power relationships can survive through the development of high levels of trust, leading to increased levels of commitment. Furthermore, they show that relationships are built on the intentions and interactions of firms and individuals and that relationship development is not smooth and monotonic through various stages. However, they did not look at how different supply chain practices between partners develop over time and what triggers these practices.

Another important study on the development of interorganizational relationships is the recent work of Jap and Anderson (2007). They used data from over 1,500 resellers in a distribution channel of an agricultural chemistry company and tested some of the propositions of two existing life-cycle theories of interorganizational relationships (see more information on these theories below). They found that the maturity phase is not the pinnacle of the relationship life-cycle and that the relationship properties of this phase are not different from those of the build-up phase. Furthermore, they stressed that individuals play a crucial role in these interorganizational relationships (Jap and Anderson 2007).

Building on the work of Jap and Anderson, we can state that the literature describes two theories of interorganizational life-cycles: The DSO theory (Dwyer et al. 1987) and the RV theory (Ring and Van de Ven 1994). Although the theories start from similar premises, they end up in different hypotheses. Both theories rely on MacNeil's (1980) theory of relational norms and share the premises that equity and performance matter equally to participants. Both theories agree that building strategic alliances takes time and involves an evolution in the sharing of norms. In the beginning of the relationship, low or even no norms, referred to as shared purposes, values or congruence, are present. Norms grow during the development of the alliance (Dwyer et al. 1987; Ring and Van de Ven 1994, Jap and Anderson 2007).

However, the literature also highlights two key differences regarding the development process and the role of relationship characteristics (Jap and Anderson 2007).

A first difference is the development towards supplier alliances. DSO (Dwyer et al. 1987) posits that the traditional relationship might develop towards a supplier alliance through a predictable, stable series of events in a fixed order: an awareness, an exploration, an expansion (build-up), a commitment (maturity) and finally a decline and perhaps a dissolution phase. The RV (Ring and Van de Ven 1994) theory, on the other hand, describes different processes of developing towards an alliance: a negotiation phase to start a relationship, an agreement phase, the execution of the agreement and then finally an assessment of the execution and a termination phase. In the RV theory, the partners need to go through this cycle again for each project. As such, they describe the development towards an alliance as a continuous cycle of events that occur within each of the phases as described by the DSO framework. RV is thus describing a cyclical theory whereas DSO is talking about different stages. Narayandas and Rangan (2004) suggest that relationships are built on the intentions and interactions of firms and individuals and that relationship development is not smooth and monotonic through various stages.

Another difference in these theories is the role of relationship characteristics versus individuals in building up the relationship. While RV (1994) and Jap and Anderson (2007) are highlighting the role of individuals in building strategic alliances, DSO is rather focussing on the relationship characteristics of the alliance.

Next to the two differences in the life-cycle theories of interorganizational relationships, the literature also presents two competing arguments on the development of interorganizational relationships.

First, the literature describes differences in the value of relationship-specific assets. Asset specificity refers to assets that are customized to the relationship and difficult to redeploy without a significant loss of productive value. Williamson (1996) argues that the best protection against opportunism in an alliance is to invest in relationship specific assets. However, Ghoshal and Moran (1996) argue that the role of these specific assets is minor. Based on the results of chapter 4, we argue that asset specificity, measured here in the form of IT investments, create interdependence between the parties and higher levels of operational benefits and some advanced integrative practices (chapter 4).

Both RV and DSO argue that trust develops gradually throughout the relationship. The literature describes trust as a central organizing construct (McEvily et al. 2003) which plays a major role in

supplier alliances. While Ghoshal and Moran (1996) and McKnight et al. (1998) argue that trust arises naturally and may be high from the start of the interactions, Dwyer et al. (1987) and Jap and Anderson (2007) are talking about a gradual growth of these relationship characteristics, such as trust and interdependence, which will be rather low at the beginning of the relationship and evolve gradually according to the different stages of the life-cycle theory.

Based on this literature review, we can conclude that there are still a lot of unclarities concerning the development of inter-organizational relationships.

## **6.3 Research Methodology**

We conducted case study research to answer ‘why’ and ‘how’ questions and as such to provide us specific explanations (Eisenhardt 1989). More specific, we used a retrospective approach (Pettigrew 1990, Pentland 1999). As discussed by several researchers, case study methodology is used for research questions in which theory is rather immature, simplistic and in need for richness (Eisenhardt 1989, Meredith 1998, Vos et al. 2002, Yin 2003). Although multiple studies have been done on the topic of supplier integration, little attention is given to understanding and explaining the development of these alliances. First, most of these studies are dominated by cross-sectional studies, while we apply a retrospective design, allowing for collecting data on how processes of integration evolve over time. Second, previous studies mostly collected responses from the buyer company and ignored the supplier’s view. Case study research will enable us to collect the view of both buyers and suppliers and to explain this complex phenomenon within a natural setting (Weick 2007). The research design is thus a multiple case, inductive study. We analyse 5 cases for which we gather data from both the buyer’s and supplier’s perspective.

### **6.3.1 Sampling**

We selected our cases based on a theoretical sampling method (Eisenhardt 1989, McCutcheon and Meridith 1993, Miles and Huberman 1994). First, we set out to select companies with leading integration practices. As such, our findings might have practical value for other companies. We identified these leading integration practices based on a cross-sectional survey, in

which we asked manufacturers to describe the integration practices with a successful and unsuccessful supply chain partner. Based on this survey, we grouped the manufacturers according to their level of integration practices (see chapter 4). 25 companies were classified as advanced alliances and as such selected for this study. A second sampling criterion was based on the supply chain dynamics of the manufacturing plant involved in the integration practices. Since our second study (chapter 4) shows that business dynamics have an impact on supply chain integration practices, the results of Lagnevik et al. (2003) have guided us in the search for appropriate cases. They analyzed the dynamics of the food industry and compared it with some other industries like telecom and electronics. The food industry was characterized by low growth, innovativeness and investments, or what we call low dynamics, compared to these other industries. Furthermore, our second study (chapter 4) shows that business dynamics has an impact on supply chain integration practices. As such, based on Eisenhardt's suggestion to contrast key issues (Eisenhardt 1989), we selected companies in the food industry, which are characterized by low supply chain dynamics, and companies in the electronics industry, with high supply chain dynamics.

To increase the comparability of our cases, we selected top 1500 buying companies of (based on turnover) and top 10 in their specific industry. These companies can thus be classified as large companies.

We also made sure to include different types of products (i.e. goods versus services) and different levels of strategic importance of the product for which the integration practices were analyzed. This should help to assure the external validity of our findings (Eisenhardt 1989, McCutcheon and Meridith 1993).

### **6.3.2 Data collection**

A semi-structured interview tool was developed for our interviews (see Appendix A). Although we used this tool, also talks about novel or meaningful concepts were encouraged during the interview. The unit of analysis was a cooperative project between a buyer and supplier. Consequently, we interviewed both people from the buyer and the supplier side of the integration project.

Data on the alliance trajectories were collected in a retrospective way, allowing for a focused data gathering process (Leonard-Barton 1990). Unconsciously accepting respondent bias might occur in retrospective studies, leading to confusion about cause and effect relationships (Leonard-Barton, 1990). Therefore, we triangulated our data, applying multiple data collection techniques, including interviews and review of documents (Jick 1979). Based on suggestions of Pettigrew (1990) and Pentland (1999), we made an explicit distinction between two different data collection steps in our analysis, going from the evolution of surface levels to deeper levels of data collection and analysis. First, we conducted an unstructured interview with our key informant and studied relevant documents (i.e. contracts, reports and presentation and publicly available data). This information enabled us to construct a graphical representation of the chronology of the major events that had taken place within each trajectory (see Figure 6.1 and 6.5). Second, we conducted semi-structured interviews (Kvale 1996) with multiple manager involved in the alliance. These interviews were conducted individually, face-to-face, and in the native language of the interviewee to maximize the informant's ability to express his or her thoughts, feelings and opinions. These interviews are structured according to the chronology of the major events. At this stage, we also re-examined the available documents to check whether the information from the interviews were supported by the documents. When discrepancies between these data sources or between respondents were observed, we asked for additional information.

The first point of contact was typically a supply chain director, VP or purchasing director. We first contacted the buying company by phone and asked the respondent to confirm our findings from the survey that they were involved in integration practices with some of their suppliers. If this was the case, we asked them for an initial face-to-face interview. During this interview, we explained the research objectives and the required time commitment for the company and its supplier. An important selection criterion was the ability of the buyer and supplier to describe the supplier alliances trajectory. This required interviewees at the buyer and supplier who were involved in setting up the supplier alliance and as such had already been in the company for a relatively long time. Furthermore, we asked the company to describe the business context and the advanced integration practices with different suppliers. This enabled us to select a case which fitted into the research objective of our study. In this first stage, 7 meetings were organized,

leading to the selection of five case studies. An overview of the five cases that are included in our study can be found in Table 6.1.

After selecting a case, we conducted the second data collection step. We had a second interview with our initial contact person and asked this manager to describe in-depth the evolution of the strategic alliance which we selected for the purpose of this research project. We also asked him/her to introduce us to the initial buyer and to other people in the buying company involved in the strategic alliance. Furthermore, we asked them to introduce us to the supplier, which could be the CEO or the sales manager of the supplying company. As such, we interviewed multiple people involved in setting up integration practices between the buyer and supplier. All these interviews were conducted at the firm's premises or at the supplier's premises. In total, we conducted 19 interviews. The duration of each interview ranged from 45 minutes to 3,5 hours. All interviews were recorded.

We also asked all respondents to fill in the survey which we used in chapter 3 and 4. In addition, documentation on the companies involved in the integration practices were collected and analyzed (see Table 6.2). In some companies, we conducted a plant tour to better understand the context and the product. In general, we can thus state that data triangulation was accomplished by interviewing multiple respondents involved in the integration practices and through different sources of data.

We collected data on 5 supplier alliance trajectories. We stopped the data collection since new interviews did not provide new information to our understanding of the research, i.e. since the incremental improvement to theory was minimal (Eisenhardt 1989).

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Include Table 6.1 about here

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## **6.4 Data analysis and discussion**

In the final stage, we interpret the cases in order to answer our research question. We used here an inductive approach, coupling within-case analysis with between-case analysis (Eisenhardt 1989, Yin 1984). Standard coding procedures (Miles and Huberman, 1984) helped us to identify



constructs and relationships within each single case and then compare these constructs and relationships across the cases. Nvivo 1.1 (Fraser 1999) was used to store, code, index, structure, and record the data and information about the data throughout the interactive data collection and analysis processes. This permanent electronic database includes all materials we used directly in the analysis. After each interview, we made an entry in the case study journal (reflective journaling), and we created an interview transcript. The transcripts ultimately became part of the NVivo (Fraser 1999) database. The journal entry contained information about the role of each interviewee and the interviewer's reflections on the interview situation. Furthermore, we kept track of our ideas and first findings in a journal. This journal was not included in the NVivo database, but rather it was seen as a separate source for keeping track of information relevant to the project. It also allowed us to remember the logic we used for making decisions throughout the research process. Multiple researchers, i.e. a master student and I, coded the constructs and the relationships between the constructs in the transcripts and compared the coding. Differences in the coding were discussed to reach a consensus.

Based on our survey data, we classified our cases based on the level of integration. This data can be found in Table 6.2. As we see, the cases are all categorized as being in the maturity phase and as being structurally integrated (based on the information flow characteristics as described in study 2 (chapter 4)). This confirms that the cases fit with our selection criteria (i.e. they score high on all three criteria of information quality, information sharing and structural integration). The inter-rater reliability (Boyer et al. 2000) of the different respondents are between 0.82 and 1 for each of the construct, which suggests high levels of agreement between the respondents.

Consistent with the procedure suggested by Miles and Huber (1994) and Eisenhardt (1989), multiple case interviews were first conducted to identify the practices deployed and their development over time. Once the within-cases were analyzed, between-case analyses were undertaken to compare the different cases.

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Include Table 6.2 about here

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## 6.4.1 Within-case analysis

As described before, we will first examine each case individually. This within-case analysis offers the details of the five cases used in this study.

For each case, we describe (1) the background information (product, market and relational context), (2) the triggers and governance of supplier integration and (3) the development of a supplier alliance. Table 6.3 and 6.4, and the text below describe these variables as (1) product characteristics, market characteristics and relationship characteristics, and (2) governance of the alliance, members involved, triggers of alliance development and perceived benefits of the alliance. Next, we (3) discuss the evolution of each of the five cases (Figure 6.1-6.5).

Appendix B provides a glossary of definitions of the concepts used in the following paragraphs.

### 6.4.1.1 Product, market and relationship characteristics

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Include Table 6.3 about here

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**Product characteristics** Each case describes the alliance for a specific good or service (see Table 6.3). While both case A and case D are about the supply of the core product for the production process of the buyer, case E is about an important, although not a core, product for the production process of the buyer. Furthermore, Cases B and C are seen as non core services towards the manufacturer. It is important to mention that all buyers claimed the product or service to be important for their company or at least for the budget or objectives of the interviewee. The supply chain director in case B for instance told us: “transportation is around 40% of my budget as supply chain director, although it is a small proportion of the total budget of the buying company.” Consequently, it is very important for the supply chain director to work closely together with this supplier and to reduce these costs. Similarly, case E is a large volume product for the buyer, but not a core product in the BOM of a television. Nevertheless, it is important to optimize the logistic flow for this material and to guarantee the supply. The main reason for this is the large variety of these cables and the short life cycle of a television. As such,

every lead buying person claimed that the good or services for which he/she started a supplier alliance, is important for the company or at least for his/her department.

If we look at the customization of the products and services of the different cases, we clearly see some differences. While case A and case C are customized towards the buyer, case B, case D and case E are standardized products. However, how the supplier works together with the buyer is for none of the cases a standardized process.

The risk of the product is also an important product characteristic. In case A, we see a clear risk of loosing supply of bio soya beans due to weather conditions. To spread this risk, the buyer asked the supplier to work in different regions. Recently, the buyer and supplier are looking for a new region where local farmers can grow soya beans. This is needed to fulfil the growing demand and to spread the risk. Risk management is also important in case E. The product life cycle of a television is short and as such managing the large variation of cables is necessary to reduce the risk of obsolescence. Finally, the product of Case D is also risk sensitive: price fluctuations may reduce the profit margins of the busbars.

**Market characteristics** Case A, which is about bio products, and case D, which is about copper busbars, concerns products that are clearly situated in growth markets. Case B, case C and case E on the other hand, are about products in mature markets. The supplier of case C told us: “further integration practices are only possible if the buying company grows”. One idea was for instance to set up a warehouse next door to the buyer. However, this was not possible at this moment, since volumes have been decreasing due to the economic situation.

**Relationship characteristics** While case A, B and D have a long history of working together before setting up a supplier alliance, case C and case D did not have this history. As such, they took some time to get to know each other before setting up integrative activities.

The supplier of case A, B and C are the sole suppliers in their product category. Supplier D and E on the other hand are the main supplier. Nevertheless, there is still a back-up supplier for the same product category. The reason for this back-up supplier, as provided by our respondents, is the need for market information and to keep the main supplier competitive. “We need to do

benchmarks on a regular basis” as said by the buyer of case E. Buyers use this market information to challenge the supplier and to enlarge their knowledge of new products in the markets.

These descriptions above suggest that some product, market and relationship characteristics of an alliance foster supply chain integration practices. Supply chain integration practices will for instance develop faster for alliances of core products, situated in growth markets and with a long relationship history.

#### **6.4.1.2 Governance, triggers, members involved and perceived benefits**

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Include Table 6.4 about here

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**Governance of the alliance and members involved** Table 6.4 indicates that all alliances are managed through regular meetings between the people involved in the integration practices. These are not only meetings between the buyer and the sales person, but also meetings with the different people involved in the integration practices. This can include logistics, finance, quality and supply chain management. These broad connections ensure a broad spectrum of optimization activities and support for the alliance throughout the company. Managers told us that this might be important to guarantee the continuation of the alliance if managers would move to another company. Furthermore, the purchasing department is still very much focused on negotiations and price reductions. Bringing in people from other disciplines broadens the view towards process cost reductions and flexibility gains.

In all cases, it was considered important to organize meetings at different levels in the organization: Not only meetings at the strategic level, but also meetings between the operational levels were organized. As such, all individuals understand the required changes and are motivated to work closely together.

In all cases, the partners regularly visit each other’s plants or facilities. In some cases, also plant audits are organized. While it is normally the buyer who visits the supplier in Case C, it is the

supplier who is yearly doing an audit at the buyer side. By doing so, the supplier highlights points of improvements in which he might help the buying company.

Furthermore, some buyers organize events for their suppliers. In case A for instance, the buyer organizes a festivity for the farmers and presents its company and products. Case E is another example. Here the buyer invites all its important suppliers and informs them on the market trends and their expectations. This allows the supplier to quickly understand the market and as such adapt easily to changes in the market.

**Triggers** Integration practices can be triggered by opportunities or threats. Case B is an example of a first integration practice that is triggered by a problem of the supplier: the supplier could not be profitable anymore at the current prices. As such, both parties came together and looked for a solution, which consisted of setting up integrative practices. However, most of the integration practices came out of an opportunity. Furthermore, also management practices, such as supplier reduction programs, can trigger more integration activities.

**Perceived benefits of the alliance** Strategic alliances help the partners to reduce process costs and increase flexibility. Both benefits have been mentioned by all the parties in the interviews. Another benefit, which is not mentioned in our definition (p. 135) is that buyers see integration as a way to ensure future business. Although contracts are still signed on a regular basis and negotiated yearly, being more integrated with the buyers makes them one of the preferred suppliers. Certainly in growing markets, this enables the supplier to grow together with the buyer. Furthermore, in all cases, also the quality of the product or service has improved after working more closely together. This is due to the additional projects that are launched after the two companies decided to work more closely together.

Integration also provides traceability in the supply chain. As such, integration is interesting for producers who want to certify their products for safety or fair trade.

### 6.4.1.3 Alliance development

**Case A** Case A concerns a supplier alliance of a market leader in soya bean products and its supplier of bio labelled soya beans. Figure 6.1 summerizes the evolution of this alliance.

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Include Figure 6.1 about here

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The buying company has a bio label (i.e. Non-GMO products: non-Genetically Modified Organisms) for which they source bio beans from South America and Asia. About 15 years ago, the companies first did business together. At that time, it was the supplier who contacted the buying company with the message that they had an interesting opportunity for the buyer: high quality bio beans. The supplier had a lot of knowledge of bio-products, while it was a rather new opportunity for the buyer at that time. Since the buying company could learn a lot from the supplier and was interested in producing bio-label products, they saw this as an interesting opportunity to work more closely together. Furthermore, there was a clear fit in the strategy of the two companies: both were heavily concerned about environmental and social issues. Although both companies had positive experiences together, it took until 2005, 2 years after a new purchasing manager was appointed, before the two parties started an integration project.

The first step towards supplier integration, which started in 2005, was to re-organize the supply chain of the bio soya beans. The supplier moved the silos closer to the sea side to optimize transportation to the buyer. Furthermore, the buyer and supplier both worked together on projects to guarantee the safety and traceability of the soya beans. This was necessary since they had to proof that their products were bio products and since they wanted to guarantee fair trade. Furthermore, the supplier had knowledge on fair trade certification and helped the buying company to obtain this fair trade certificate. They also worked together on quality improvement programs of the soya beans by visiting the farmers and working together with these farmers. To make sure to only ship good quality products, the quality inspection moved from Belgium to the oversea silos (i.e. the production country).

In 2006, the South American farmers had a bad harvest. The buying company decided to pre-finance these farmers to make sure that the farmers could produce the next year. Furthermore, open book calculations were introduced in 2008 and social investments and investments in some production tools for the farmers were made by the buying company. The buying company also decided to organize a yearly festivity for the farmers.

Since soya bean products (and certainly bio soya beans) are a growing market segment, the buying company asked the supplier to search for an additional location to farm soya beans. This should help the buyer to fulfil the increasing demand and to spread the risk of a bad harvest.

**Case B** Although the two companies were working already together since the 90s, the supplier integration activities of case B, who is active in the food industry, only started in 2005. Figure 6.2 shows the evolution of case B.

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Include Figure 6.2 about here

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In the beginning, the supplier was one of the 15, and later one of the six providers of truck transportation services for the buying company. This supplier was located in the proximity to the buying company and was the most flexible supplier of transportation towards the buyer. Since managing the different transportation providers took a lot of time and effort, the buying company decided to reduce the number of suppliers to three, including this supplier. In 2005, the supplier contacted the buying company with the message that they could not deliver the buyer transportation services at the current price anymore. The two parties planned a meeting to discuss this issue. The two parties sat together and the supplier provided the cost details to the buyer. Since the supplier was the most flexible supplier of transportation services and since the buyer was very pleased with the work of this supplier, they decided to work on a solution, which was found in working more closely together and integrating some of the operational processes.

By offering additional services to the buyer, the supplier could ask higher prices. As such, the buyer and supplier agreed that the supplier would take over the transportation planning of the buyer. This required the buyer to make this supplier the sole supplier for the deliveries to the

retailers and as such split the transportation services into retail deliveries, international transport and milk routes. This sole supplier became responsible for the total package of retail deliveries. Since the supplier could also better estimate the time needed for a specific transport, he could better plan the individual transportation services in the total planning system, which made some optimization possible.

Other new initiatives were launched after this initial integration project. For every retailer, the supplier worked out a detailed guideline with the optimal routes and the delivery procedures of the specific retailers. They worked together on safety and security projects for the truck drivers. Furthermore, the buyer gave training to the truck drivers on safety, on the products of the buyer and on the return policy of goods. Another service that the truck drivers delivered to the buying company is helping in loading the trucks.

The buyer also treated the truck drivers as its own people: they could drink a coffee at the cafeteria of the buyer and received Christmas presents and some of the benefits of regular employees of the buyer. As such, they were proud to work for the buying company.

Recently, the buyer and supplier also started projects on reducing the number of empty trucks on the road. The supplier for instance delivers to a retailer in Luxemburg and on its way back, the truck transports packaging material for the buyer.

**Case C** Case C is a supplier alliance of a packaging service provider and an electronics company. The evolution of this alliance can be found in Figure 6.3.

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Include Figure 6.3 about here

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In 2002, the supplier contacted the buying company and proposed to take over and manage the total supply of packaging material of the buying company. They presented a profitable business case to the buying company. However, since they had no previous business with this supplier, the electronics company was hesitant to work with the supplier. In 2005, the electronics company



finally decided to set up a small pilot project with the supplier to improve the preparation and delivery of the packaging of coils, which at that time was creating many logistical problems.

After this first successful project, the supplier continued to work together with the buyer on other small projects. After a number of these projects, the buyer finally decided to outsource its supply of packaging material to the supplier. This project involved kanban deliveries of the packaging material directly to the production line of the buying company. The supplier is buying FTL from the supplier of packaging material and delivers in smaller quantities twice a day, to the buyer. As such, the buying company has fewer inventories and is managing only one supplier for its packaging material (against 14 suppliers in the past). The focus of the buyer shifted from supplier management to supplier evaluation and improvement. The two parties are still setting up other joint projects to work on: process improvement and supply chain visibility projects.

**Case D** Figure 6.4 represents the development of case D. This electronics company bought its main products, copper plates, from a specialized distributor. In 2002, in a period of strong growth, the company started to look into the opportunity to buy these materials directly from a supplier of copper plates. They contacted several suppliers and asked them about their knowledge on the product and the commercial aspects. Based on this information and based on previous deliveries from this supplier via the distributor, they selected a main supplier.

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Include Figure 6.4 about here

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Since the volumes of the copper plates increased drastically, the work in capital of copper plates was enormous. Furthermore, the prices of copper showed very high fluctuations. As such, holding large amounts of stock had a huge impact on the profit margins of the buying company. To reduce the risk associated with fluctuations in the price of inventory, the buyer asked the supplier to work with consignment stock. The parties decided to set up a VMI system to manage the inventory of copper plates.

The flatness of the copper plates is very important for the conductivity of the plates. Because there were some problems with the flatness of the copper plates and since there are no specific

norms for flatness of copper plates, both parties worked together to improve this. Furthermore, the supplier now delivers certificates with information on quality specifications for each delivery to the buyer. As such, the quality inspection moved from the buyer's location to the supplier's location.

Recently, the buyer set up a production facility in China and asked the supplier to also deliver to this new production plant. Since the lead time between Europe and China is rather long, the buyer and supplier started up a risk assessment project. They are now in the phase of working out solutions and back-up plans to create a risk-management plan.

**Case E** This supplier alliance, described in figure 6.5, concerns an alliance of a television producer with a supplier of cables.

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Include Figure 6.5 about here

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Originally, in the 70s, the buyer and supplier had their plants in Western Europe. Due to shifts in the markets and in labour costs, the buyer gradually moved its plants to Eastern European facilities. There are two suppliers for cables: a Japanese one and one with headquarters in Europe. Both produce in China now and build up positive experiences with the buyer. Recently however, the European supplier was willing to follow the buying company to Eastern Europe and to start up the production of cables specifically for the buying company. This helps to reduce the lead time of 6 weeks transport from China to 2 days from an Eastern European plant. Although, the 2nd-tier supplier is still situated in China, this situation creates additional flexibility for the buyer. Since the products consist of different modules which can be combined in a large amount of different final products, the product diversification happens later in the supply chain and as such creates additional flexibility.

A cross-dock center, close to the production plant of the buyer, is used to deliver the cables in a JIT mode to the buyer. This optimizes the logistic flows between the partners. Furthermore, the two partners are planning to put a safety stock in a closeby region in case of problems with one of the production plants. As such, they try to manage supply risks together.

Furthermore, the buyer and supplier also work together on the development of new products and on screening the market. This helps the buyer and supplier to be on the edge of competition. However, the Eastern European supplier will not be the sole supplier (although the largest supplier for cables). One reason for this is that a back-up supplier can help this supplier to stay competitive, since it enables the buyer to challenge the main supplier.

## **6.4.2 Cross-case comparisons**

In the previous section, we described the characteristics of each case, the triggers, the alliance governance and how each case developed over time. In this section, we will compare, based on cross-case analysis tactics described by Eisenhardt (1989), the different cases. One tactic used here is to list the similarities and differences between the cases. Furthermore, we selected dimensions and looked for within-group similarities coupled with intergroup differences (Eisenhardt 1989).

### **6.4.2.1 Three types of integration: operational, relational and financial**

When we look at the development of the cases (see Figure 6.1 to 6.5), we can identify different types of integration practices: operational, relational and financial integration practices. Through joint discussions supported by our notes and company documentation, we ranked each company on the three types of integration: operational, relational and financial. Operational integration concerns the integration of operational (production and logistic) activities, while relational integration is about strategy building, positioning and learning from each other. Finally, financial integration concerns financial investments in the production or logistic systems (including inventories) of the other party. The qualitative evaluation of a score of L (low), M (Medium) or H (High), are shown in Table 6.5. These scores were set based on discussions of definitions and cases. The final score is a unanimous consent of the research team.

As we can see in Table 6.5, all cases score high on operational integration. This is a logical result from our research design, which selected companies who developed high levels of operational integration. However, we see some clear differences in relational and financial integration across

the cases. Case A, Case B and Case E score high on relational integration. Case A for instance scores high on relational integration since both parties learn a lot from each other and have a very open communication. Case B scores high on relational integration because employees of the supplier are seen as their own employees. Finally, Case E has high relational integration since both parties try to set out their strategy together. Case A and Case D score high on financial integration. While the buyer of case A invests in the production facilities of the supplier, the supplier of Case D invests in the inventory of the buyer.

Furthermore, we see a clear pattern of how these projects evolve (see Figure 6.1 to 6.5). This pattern is visualized in Figure 6.6. As we can see in this Figure, all cases start with an operational opportunity or threat. Based on this opportunity or threat, both parties search for better operational solutions and start optimizing processes in the supply chain, concerning quality, production and/or logistics. In a later stage, they work on more relational activities and in some cases it also evolves towards financial projects. A nice example of this pattern is case A. Both partners start a project on optimizing the supply chain flow from the farmers to the buying company. Later on, the buyer started to regularly visit the farmers and organized farmer days. Finally, they also helped farmers financially when problems arose or for more social purposes. Another example is case D. Case D started the alliance with working on quality problems. Later on, they build on the relationship by conducting more regular visits to each other and by being more integrated. Recently, they also started with consignment stocks, indicating that the supplier pre-finances the stock of the buying company.

#### **6.4.2.2 Linking the types of integration to the governance of the alliance**

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Insert Table 6.6 about here

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Table 6.6 summarizes the triggers and governance of the alliance and links it with the different types of integration. Based on this table, we could state that the degree of formalization in the governance of the alliance is linked to the level of organizational integration. Cases scoring high on relational integration seem to have both formal and informal management systems.

Furthermore, we see that alliances that are mainly triggered by the need for more flexibility are more open for relational integration. Finally, Table 6.5 suggests that alliances are not just about a buyer and a seller working together, but about two teams working together. These teams can be limited but focussed teams (e.g. case B and case D) or teams in which every functional domain is represented.

### **6.4.2.3 Influence of the pre-integration on the integration phase**

Based on data from our cases, we explore here how the pre-integration phase influences the integration phase. The cases suggest that the pre-integration phase is necessary to build trust (see Table 6.5). This is often done by increasing the communication between the two parties or setting up smaller less important projects. As such, we could state that this pre-integration phase is used to evaluate the goodwill of the partner before starting up integration projects. Furthermore, this pre-integration phase helps to assess the knowledge of the partner and to decide whether the partner is knowledgeable or flexible enough to become an important partner. Furthermore, we learn that integration helps companies not to communicate more, but to communicate in a more structural way and to better use the available information. This more efficient way of working decreases the transaction costs and improves the services of the alliance. This structural way of working together also increases the interdependence among the companies.

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Insert Table 6.7 about here

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### **6.4.2.4 Comparing environments with low and high dynamics**

We selected cases with low versus high levels of dynamics. Chapter 4 (study 3) taught us that supply chain integration practices might be different according to dynamics. Our cases also suggest differences in relational integration practices. While alliances in environments with low dynamics seem to easily build up relational integration practices, this seems to be less the case for environments with high dynamics. Furthermore, the alliances in low dynamic environments

seem to be more balanced in terms of formal versus informal processes than the alliances in highly dynamic environments (see Table 6.3 and 6.4).

## **6.5 Discussion**

In previous sections, we presented the contextually rich data and their interpretations specific to each case. This step was necessary in order to discuss the cross-case issues where we cut across the cases and built the foundation for theoretical arguments derived from data interpretation. Now, given our cross-case analyses and giving the existing literature, we articulate propositions regarding (1) how strategic alliances develop i.e. development stages, triggers and how pre-integration influences the integration phase. Furthermore, (2) we look at organizational and governance issues of strategic alliances.

### **6.5.1 Alliance development**

#### **6.5.1.1 Alliance development phases**

While the DSO framework (Dwyer et al. 1987) clearly describes the development of alliances in fixed order stages, the RV theory (Ring and Van de Ven 1994) is talking about repetitive cycles of activities until the alliance terminates. From our cases (see Figure 6.1 to 6.5), it is clear that all alliances went through the different stages as described by the DSO framework, i.e. exploration, build-up and maturity. We have no evidence for the last stage, which is the decline phase, since this is not within the scope of this paper. We see that, once the partners have decided to set up an integrative practice, the partners naturally evolve towards the maturity phase of the alliance. (However, since we are only looking at successful supplier relationships, we need to stress that this finding might not be generalizable for non successful supplier alliances.) As the purchasing manager of case B describes: “The role of the parties grew during the development of the relationship“. Similarly, the manager of case A described: “In the beginning, we had no clear end goal in mind. We started with a vision and only looked in a later phase at specific optimization projects.” When this is not possible (e.g. because both partners never worked together before), both partners will not immediately jump into these integrative projects. They will start with

setting up small initial projects to get to know each other and to build trust (or in other words ‘explore’). This will enable them to start up integrative practices in later stages (i.e. build up projects). On the other hand, we see that partners are constantly developing and conducting new integrative projects after the initial integration project. As such, once a certain level of integration is reached, managers set up new projects to keep the alliance alive. An alliance is thus not just evolving as a fixed number of stages, but at a more mature level, it becomes a process of continuously improving and working on the alliance. All managers described this continuation of different projects as important since it guarantees the interaction between the parties and keeping high levels of commitment and trust in the alliance. As such, they describe an established alliance as a cyclical process of new projects. We could thus formulate the following proposition:

**Proposition 1:** *Successful supplier alliances develop in fixed order stages of evolution: i.e. exploration, build-up and maturity. However, when the build up level is reached, continuous new projects develop in a cyclical way to maintain the alliance.*

We learn from the cases that most supplier alliances grow organically. They are in most cases not planned by any of the parties from the start. An exception is case C. From the beginning, the buyer of case C already wanted to set up integrative processes of managing the packaging supply chain of the buyer. However, since there was no previous relationship between both partners, the buyer was not willing to start up these integrative practices. They decided then to start up some smaller projects to get to know each other and to build trust. Three years later, when the buyer was convinced by the success of the current projects, they finally decided to outsource their packaging supply chain to this supplier. As such, we could say that in this case the supplier had specific intentions and knew already from the beginning how the relationship should evolve. In the other cases however, the alliance grew via interactions between the buyer and the supplier based on problems that arose or the willingness of the partners to further optimize the processes of working together. This leads to the following proposition:

**Proposition 2:** *The alliance grows organically via interaction, negotiation and sense-making processes. It is not a planned process.*

Furthermore, we see a clear pattern of how these projects evolve. All cases start with an operational opportunity or threat. Based on this opportunity or threat, both parties searched for better operational solutions and started to optimize processes in the supply chain, concerning quality, production and/or logistics. In a later stage, they work on more relational activities and in some cases it also evolves towards financial projects. Our analyses also suggest that some of the characteristics co-vary with specific integration projects and that some management aspects are more prominently linked to some integration types. A mix of informal and formal governance is for instance more likely for alliances with relational integration than without.

**Proposition 3:** *Alliances start with operational, then relational and then financial integration activities.*

### **6.5.1.2 Triggers for more integration**

Supplier alliances are triggered by internal drivers such as process costs and process flexibility. Although in some cases, external drivers such as an economic crisis, high fuel prices or large fluctuations in prices, might trigger companies to work on process costs and flexibility by setting up integrative practices. Except for case A, which started with a business opportunity, all alliances started in a situation where one of the partners struggled in terms of costs or flexibility in difficult periods. They sit together with a partner who can help the company to reduce these costs or increase revenue or flexibility. Our analysis support that cases focussing more on the flexibility aspects in the supply chain, will work more on relational integration. A similar conclusion can be found in chapter 4 (study 2): more flexible environments are correlated with higher levels of integration practices.

Based on these case studies, we could distinguish two situations that lead to more advanced forms of supplier alliances: cases with high risks and/or complexity and high growth levels. If the complexity or risk is high, supplier alliances can really help to reduce process costs.



Alliances in growing markets or for buyers with a growing sales volume are also favourable. The supplier is willing to invest more since it will result in growing sales volumes.

Our cases suggest that alliance formation co-varies with supply base reduction programs. With a limited number of suppliers, the benefits of strategic alliances are enormous and easy to implement. In all cases, we saw that the buyer had only one supplier or in some cases two (one main supplier and a back up supplier to spread risks). “A limited number of suppliers enables the buyer to evolve from supplier negotiation to supplier management”, as described by the supply chain manager of case B. The role of the buyer as such changes from a negotiator to a project improvement manager.

**Proposition 4:** *Supplier alliances are triggered by (1) the necessity to reduce process costs or increase flexibility and (2) supplier reduction programs. As a consequence, the role of the buyer changes from a negotiator towards a project improvement manager.*

**Proposition 5:** *Relational integration is more prominent in alliances which exist already for a long time, use both formal and informal communication systems and focus mainly on service aspects (instead of cost) in the alliance.*

### **6.5.1.3 Linking the pre-integration and the integration phase**

The data supports that companies first have to build trust in the alliance before moving forward with integration practices and as such create interdependencies between the partners. Although Ireland et al. (2005) states that relationships established to successfully pursue environmental opportunities may benefit from an imbalanced power situation without the existence of trust, we did not find support for this statement. The supplier of case C for instance said: “Without trust, we would not have been able to start up an integration project.” Our data suggests that high levels of trust need to be developed in the pre-integration phase before organizations even want to commit and invest in the relationship. This finding is also supported by chapter 4 (study 3) and by Narayandan and Rangan (2004), who found that trust should be created first in order to obtain commitment. The life-cycle theories (DSO and RV) are talking about a gradual growth of the relationship characteristics, such as trust and interdependence, which will be rather low at the

beginning of the relationship and evolve according to the different stages of the life-cycle theory. However, our cases indicate that trust does mainly develop in the pre-integration phase or at the beginning phases of the strategic alliances and as such is already at a high level before investing in the relationship. This is also supported by Ghoshal and Moran (1996) and McKinght et al. (1998).

**Proposition 6:** *A pre-integration phase is needed to build high levels of trust before starting up integration activities. Only in later stages, when integration activities are in place, interdependence is created.*

### **6.5.2 Governance of the supplier alliance**

A supplier alliance is not just about a buyer and a supplier working together. It is about different individuals from both organizations working together. The buyer and supplier sit together regularly to evaluate the alliance and to talk about current projects and plans. However, it is also important to create links with other functional domains such as quality, finance, marketing and at the general management level. These multiple contact points have two purposes. First, it anchors the relationship into the organizations. If the buyer or supplier would leave the company, the alliance will have a larger opportunity to survive since other persons in the organization support this alliance. Furthermore, it broadens the scope of the alliance and the projects on which both partners work together. Since every functional domain has its own objectives, this multi-functional approach might help to think further than just a single department's objective. In case C for instance, purchasing was originally concerned with price savings. By working together with other departments, new objectives were created for this purchasing team: not only price savings, but also process savings were seen as important. The quality manager of case D told us: "Multiple people of our company are sitting in the meetings with the supplier. Everyone (i.e. purchasing, quality and production) is involved in the relationship."

Setting up an alliance requires both buyers and suppliers to be process oriented and even entrepreneurial. Both partners need to listen to each other, understand each others processes and come up with a solution that benefits both parties. This requires the parties to be able to understand each others situation and to find a non opportunistic solution. This is totally different

from the 'normal' thinking pattern of the traditional purchaser who wants to buy at the lowest price possible. As such, we could formulate the following propositions:

**Proposition 7:** *Advanced supplier alliances are supported by multi-functional teams.*

**Proposition 8:** *Advanced supplier alliances are set up by entrepreneurial managers who are willing to listen to each others business problems and opportunities.*

## 6.6 Conclusions

This study makes several contributions to the study of a life-cycle theory of strategic alliances. During our literature review and interviews, we have uncovered gaps in the knowledge of the development of supplier alliances. We developed propositions on how buy-sell relationships develop towards supplier alliances and what triggers the different stages of strategic alliances. Furthermore, we developed some propositions on how strategic alliances should develop and should be managed over time.

Crucial in the development of these alliances is the willingness of both parties to search for solutions that are specifically tailored to the problems of the partners in the relationship and the environment of the alliance. Furthermore, we learned that a strategic alliance is not just about creating an integrative operational process between both partners, but is about continuously working together to improve the delivery process. Both partners need to understand each others processes and need to be willing to implement tailor-made solutions to these processes.

We also learned that buy-sell relationships first evolve towards operational integration practices. This requires high levels of trust and a trigger to move towards more integration. This trigger can be a supplier reduction program, the need to improve operational performance or an accident that triggers risk assessment or the need for more customization. Longer term alliances may also trigger relational integration, which is about integration on strategic levels. Finally, partners can also decide to financially integrate. Companies invest here in each other's inventory or in pre-financing certain activities. Our cases suggest that this is done for core products in growth markets.

As with any case study research, there are limits to the findings and conclusions generated in this study.

A first limitation is that we limited our study to large firms that developed supplier alliances with high levels of integration activities. While our theoretical sampling approach should aid generalizability within this domain (Rosenthal and Rosnow, 1991), our findings may not be applicable to smaller companies. Furthermore, we only looked at successful supplier alliances. As such, we had not the possibility to understand the declining phase of supplier alliances or to understand why some alliances do not succeed.

Another limitation is the definition of low versus high supply chain dynamics. We based this definition on industry aspects as described by Lagnevik et al. (2003). However, also other aspects are determining the dynamics of the supply chain such as the good or the service itself.

Furthermore, we have chosen to collect data on a limit number of cases. As such, we need to be careful in formulating these propositions. Further confirmatory research should be conducted to test the falsifiability of these propositions. This can be done by following-up a larger number of alliances over time and collecting in-depth data on these alliances.

A third limitation is related to our retrospective data-collection strategy. Despite our efforts to maximize the reliability of our data (i.e. multiple data collection techniques, multiple informants), our data collection strategy restricted the ability to obtain a micro-level understanding of some essential processes and/or events. We therefore point to real-time research as a viable option to further elaborate on the findings that emerged from our study.

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## Tables and Figures

Table 6.1: Overview of sample firms

Case	Buying company	Supplier company	Product characteristics	Interviewees	Number of interviews
Case A	Major producer of soya bean products	Trader of fair trade products	main product: bio soya beans	strategic purchasing manager, strategic buyer, marketing manager, quality manager, CEO of supplier	5
Case B	Major producer of milk products	Transportation services	service: transport to retailers	supply chain director, transportation manager, CEO of supplier	4
Case C	Major producer of connectors for the automotive and communication sector	Supply chain packaging services and logistics	service: managing logistics of packaging suppliers	strategic purchasing manager, initial buyer, logistic manager, CEO of supplier	5
Case D	Major producer of busbars	Major producer of copper plates	main product: copper plates	strategic purchasing manager, quality manager, CEO of supplier	3
Case E	Major producer of televisions	Major producer of cables	main product: cables	strategic purchasing manager, initial buyer, sales and marketing manager of supplier	3

**Table 6.2: Information flow characteristics**

	Case A	Case B	Case C	Case D	Case E
Information sharing	4,4	4,3	4	3,7	4,2
Information quality	4,3	4,3	3,8	3,9	4,1
Information participation	4,5	4,7	3,9	3,7	4,2
Structural system integration	<ul style="list-style-type: none"> <li>°adapted logistic flow</li> <li>°adapted product</li> <li>°adapted quality requirement</li> <li>°specific quality inspection at Supplier</li> <li>°buyer investment in production assets of supplier</li> </ul>	<ul style="list-style-type: none"> <li>°supplier took over transport planning</li> <li>°truck drivers as extension of the buyer</li> </ul>	<ul style="list-style-type: none"> <li>°supplier took over purchasing of specific product category</li> <li>°kanban deliveries</li> </ul>	<ul style="list-style-type: none"> <li>°specific quality inspection at supplier</li> <li>°VMI</li> </ul>	<ul style="list-style-type: none"> <li>° locating close to each other</li> <li>°optimizing the logistic flow</li> </ul>
Relationship phase (based on Jap and Anderson, 2007)	3 -maturity phase	3 -maturity phase	3 -maturity phase	3 -maturity phase	3 -maturity phase

1 to 5 likert scales



Table 6.3: Product, market and relational characteristics

	Case A	Case B	Case C	Case D	Case E
Product characteristics	<p><b>Good, Core</b> the core supply of bio beans for the bio label product of the buyer</p>	<p><b>Service, Non core</b> a transportation service for the final delivery of the product to the retailer</p>	<p><b>Service, Non core</b> a service for the supply of packaging material (bundling of all packaging material)</p>	<p><b>Good, Core</b> the core supply of copper plates (core for the production)</p>	<p><b>Good, Non core</b> supply of power cables for televisions</p>
	<p><b>Customized</b> non-GMO beans with high levels of proteins</p>	<p><b>Standardized</b> a standard service, but with high flexibility</p>	<p><b>Customized</b> a service tailored towards the needs of the buyer</p>	<p><b>Standardized</b> a standard product with specific customer sizes</p>	<p><b>Standardized</b> a standard product with specific customer sizes</p>
	<p><b>Risk sensitive</b> conditions of beans depend on the weather conditions</p>	<p><b>Not risk sensitive</b></p>	<p><b>Not risk sensitive</b></p>	<p><b>Risk sensitive</b> risk for high fluctuations in copper prices</p>	<p><b>Risk sensitive</b> fast product life cycle</p>
Market Characteristics	<p><b>Growth market</b> growing competitive market</p>	<p><b>Mature market</b> highly competitive with pressure on prices</p>	<p><b>Mature market</b> a service in a highly competitive market of packaging</p>	<p><b>Growth market</b> demand for copper plates is growing</p>	<p><b>Mature market</b> power cables for televisions are a rather stable market</p>
	<p><b>Low dynamics</b> food</p>	<p><b>Low dynamics</b> food</p>	<p><b>High dynamics</b> electronics</p>	<p><b>High dynamics</b> electronics</p>	<p><b>High dynamics</b> electronics</p>
Relationship Characteristics	<p><b>Long-term relationship</b> relationship of 30 years</p>	<p><b>Long-term relationship</b> relationship since 90s</p>	<p><b>Recent relationship</b> relationship of 7 years</p>	<p><b>Recent relationship</b> relationship since 2005</p>	<p><b>Long-term relationship</b> relationship of more than 30 years</p>

<b>single supplier</b>	<b>Single supplier</b>	<b>Single supplier</b>	<b>Two suppliers</b>	<b>Two suppliers</b>
single supplier for bio soya beans, but sourcing in different countries to spread risks	single supplier for transportation services to the retailers (other transport companies for other services like international transportation)	single supplier of these type of services to the buyer. The buyer still negotiates the contracts with the individual suppliers	the buyer has a small back-up supplier from which they buy small amounts	2 suppliers whom the supplier challenges to be competitive

**Table 6.4: Governance, members involved, triggers and perceived benefits**

	Case A	Case B	Case C	Case D	Case E
Governance of the alliance	<p><b>Formal and informal processes</b></p> <p>Mindmap (follow up guide for all the projects)</p> <p>Yearly farmer days to build alliance and to understand what lives in the field</p> <p>Regular visits to the farmers</p>	<p><b>Formal and informal processes</b></p> <p>Regular following-up meetings at management level (every 3 months) and at operational level (every month)</p> <p>Formal evaluations of performance and setting up action plans for improvement</p>	<p><b>Formal processes</b></p> <p>Regular meeting with different people of the team</p> <p>Yearly audit at the buyer's company to look for process improvements</p>	<p><b>Formal processes</b></p> <p>Regular meetings with different people of the team</p> <p>Yearly audit at the supplier</p>	<p><b>Formal and informal processes</b></p> <p>Regular meetings with different people of the team</p> <p>Boyer organizes supplier days for all its important suppliers. They discuss the trends in the sector.</p>
Members involved	<p><b>Extended team</b></p> <p>purchasing, quality, marketing, supply chain</p>	<p><b>Limited team</b></p> <p>transport, supply chain</p>	<p><b>Extended team</b></p> <p>purchasing, supply chain, logistics, finance</p>	<p><b>Limited team</b></p> <p>purchasing, quality,</p>	<p><b>Extended team</b></p> <p>purchasing, quality, production, supply chain</p>

Trigger of first integration project	<p><b>Mainly flexibility</b></p> <p>Both partners integrated their processes in the first place to deliver a high quality product with respect for social issues. They also succeed in reducing costs.</p>	<p><b>Mainly cost reduction</b></p> <p>The supplier was not able anymore to deliver transportation at current prices. Both sat together to look for ways to reduce costs for both parties. Also a supplier reduction program was set up.</p>	<p><b>Mainly cost reduction</b></p> <p>The supplier showed the buyer how he can help him with reducing costs. Yearly audits are mainly focused on how to reduce costs.</p>	<p><b>Mainly cost reduction</b></p> <p>Both parties work together to reduce the risks in the supply chain and the cost associated with these risks.</p>	<p><b>Mainly flexibility</b></p> <p>Both parties want to reduce the lead time since the life-cycle of the good is low compared to the logistic lead-time</p>
Perceived benefits	<p><b>Flexibility and costs</b></p> <p>Enabling the growth of bio products</p> <p>Guarantee traceability: an important aspect for fair trade</p> <p>optimizing process costs</p> <p>continuous improvement model</p>	<p><b>Flexibility and costs</b></p> <p>Increasing flexibility and delivery performance to retailer</p> <p>Decrease costs</p>	<p><b>Costs</b></p> <p>Decrease inventory costs</p> <p>Decrease costs of warehouse (reception of goods)</p>	<p><b>Costs</b></p> <p>Reduce working capital for the buyer</p> <p>Growth of sales for supplier due to high Quality offerings</p> <p>work on the quality of the product</p>	<p><b>Flexibility and costs</b></p> <p>Optimizing the supply of cables</p> <p>Creating a more flexible supply</p>

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**Table 6.5:** Cross-case comparisons of different types of integration

	Case A	Case B	Case C	Case D	Case E
operation integration	H	H	H	H	H
relational integration	H	H	M	M	H
financial integration	H	L	M	H	L

**Table 6.6:** Cross-case comparisons of alliance management characteristics

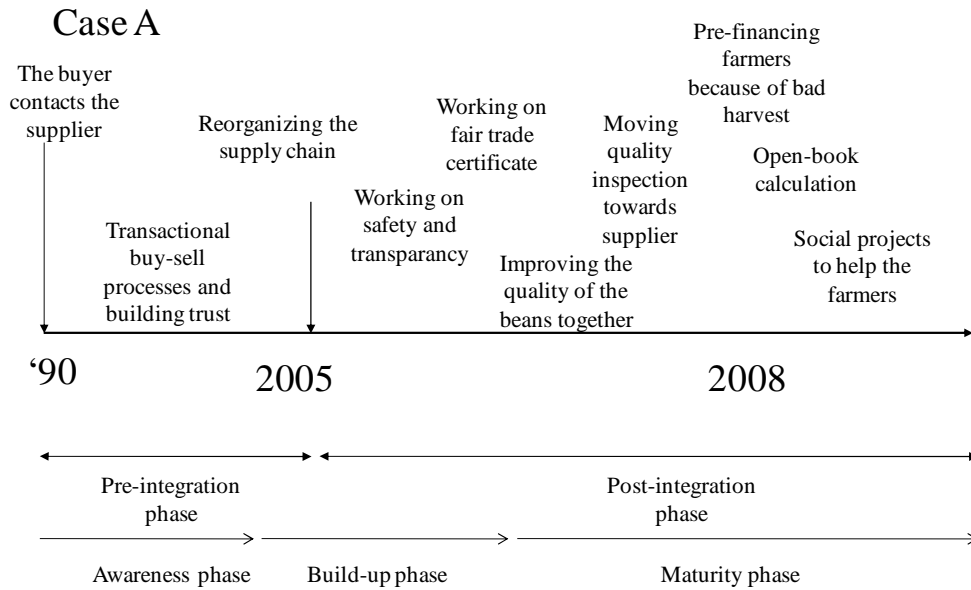
	Case A	Case B	Case C	Case D	Case E
Trigger for more integration	mainly flexibility	mainly cost reduction	mainly cost reduction	mainly cost reduction	mainly flexibility
Team members involved	extended team	limited team	extended team	limited team	extended team
Formalization of management	formal and informal processes	formal and informal processes	formal processes	formal processes	formal and informal processes
operation integration	H	H	H	H	H
relational integration	H	H	M	M	H
financial integration	H	L	M	H	L

**Table 6.7:** Pre-integration versus integration phase

	Case A	Case B	Case C	Case D	Case E
Trust					
before operational investment	4,5	4,25	4,1	4,5	4,3
after operational investment	5	4,25	4,3	4,7	4,4
Interdependence					
before operational investment	3,5	3	3,2	3	3,4
after operational investment	4,25	4,2	3,8	3,7	4

1 to 5 likert scales

**Figure 6.1:** Chronology of major events of Case A



**Figure 6.2:** Chronology of major events of Case B

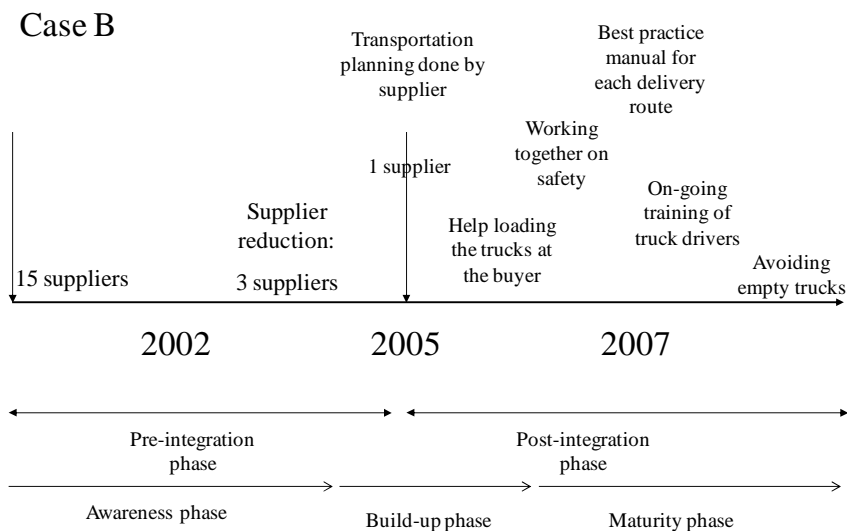


Figure 6.3: Chronology of major events of Case C

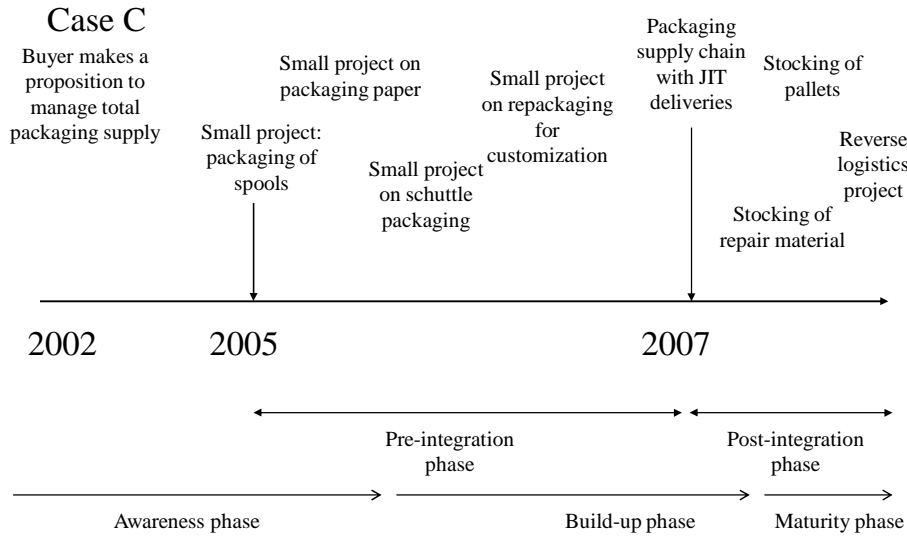


Figure 6.4: Chronology of major events of Case D

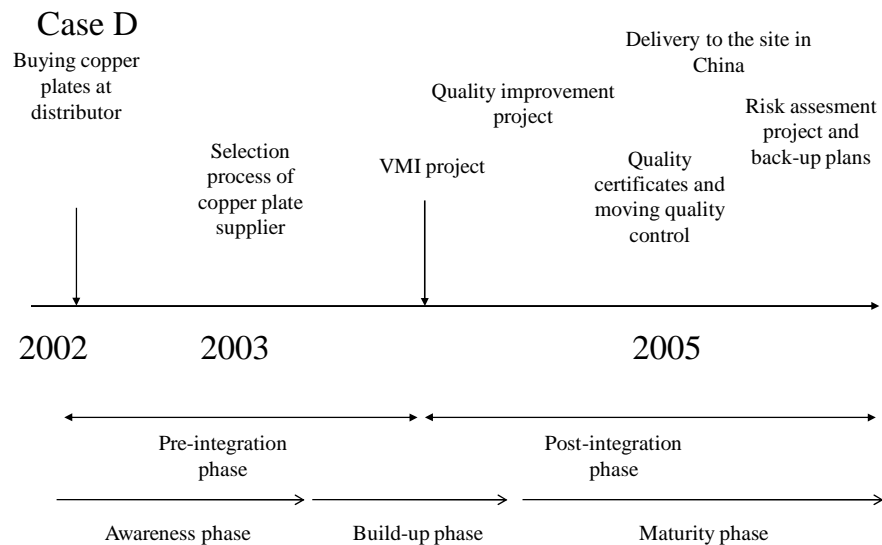


Figure 6.5: Chronology of major events of Case E

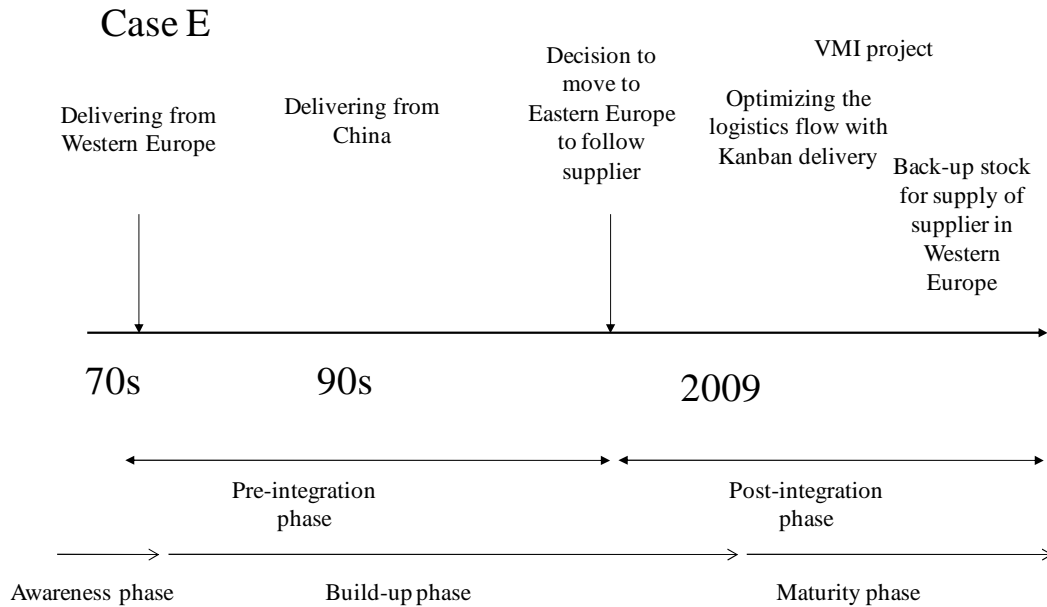


Figure 6.6: Time-line of supply chain integration practices

	1990	1995	2000	2005	2009
Case A	pre-integration			Operational	Relational Financial
Case B	Pre-integration			Operational	Relational
Case C				Pre-integration	Operational Relational Financial
Case D				Pre-integration	Operational Relational Financial
Case E	Pre-integration				Operational Relational

## Appendices

### Appendix A: Interview guide (open interview)

This document is a guideline specifying the questions we would like to address during the interview. During this interview, we will ask questions concerning the business environment, the total supply base and a specific supplier alliance.

**Definition of a Supplier Alliance:** *Supplier alliances seek to develop mutually beneficial, longer-term relationship with the best of their suppliers, working with them much more closely than with traditional contract-based, arm's length relationship. Furthermore, these longer-term contracts make the suppliers and/or buyers more willing to invest in skills or technologies specific to the partner firm. These investments are specific investments towards the relationship and can include technology, IT, procedures, skills or location issues.*

### **General questions regarding business environment**

- What are the key competitive challenges facing your business unit?
- What major changes in competition have you undergone in the last years?
- How does purchasing (and more specific through supplier alliances) impact your business unit's ability to compete?
- How much control does your firm have over its product technology?

### **Questions about the total supply base**

- How many suppliers do you have? (all suppliers versus key suppliers)
- With how many suppliers do you have a supplier alliance?
- Are the strategic suppliers 'sole suppliers' or how many suppliers do you have in the same category?
- Which product(s) do the strategic suppliers deliver? Where are these strategic suppliers located (Belgium/Benelux/Europe/other continent)?
- Give some examples of 'close or integrative' relationships and a 'not close' relationship and additional examples of relationships that might fall between the two extremes.
- Does your company have a specific strategy for supplier alliances (or the broader base of suppliers)? Are there any policies?
- How do you assess suppliers? Is that different according to the type of supplier?
- Why do you work with some suppliers closer together? What are determining factors? What are the trade-offs involved in these decisions?



- the product
- the location of the supplier
- the openness of the supplier
- the personal relationship
- the willingness of the supplier to collaborate
- the reputation of the supplier
- history
- others?

- How are other managers in your company involved in creating supplier alliances?

### Questions about the specific Supplier Alliance

Please pick **one Supplier Alliance** with whom you are highly involved and for which one of the partners did make a **relationship specific investment**.

-What type of products does this supplier deliver?

- What kind of relationships do you have with this supplier?

- a. Which type of info do you share with the supplier?
- b. Do you use structural ways of working together?
- c. What are the idiosyncratic assets (i.e. specific for the alliance e.g. specific procedures, technology, human assets, investments) in the alliance?
- d. What action plans did you do together during the last three years? What did change during the last three years?
- e. Who is involved in these changes (cross-functional team,...)?
- f. What was the trigger for implementing changes?
- g. If you started up pilot projects? With whom did you start these up? Why these parties?

- How did the alliance evolve?

- a. When did the alliance start?
- b. How did it evolve?
- c. What was the reason for starting up the alliance? What was the initial intention of the alliance?
- d. What were the difficulties in setting this up? Are there disadvantages?
- e. How do you see this evolving in the future? What are your expectations?

- In which year did you (or your partner) do idiosyncratic investments in the alliance? Did it require a lot of negotiation? Contractual difficulties?

- Which type of idiosyncratic investments?

(human/IT/procedures/tools/location)

- What factors are involved in deciding to invest in these specific assets? What analysis was involved?

- How did this change the alliance in terms of trust, commitment, formality, standardization, communication (operational and strategic level), conflict resolution techniques?
- How often do you communicate? Are these communication efforts formal or rather informal?
- Who initiated the decision to do the investment (initial and decision to invest)? What was the motivation? How did one party convince the other party to participate?
- On what domains do you work together in the different phases?
- Are there differences in culture? Does that effect the relationship? How is it different to work with international versus not international suppliers?
- What was the focus of relationship during the last three years? Now?
- How did this alliance help you to improve the performance?
- What are the future perspectives?

Thank you!

#### Appendix B: Glossary of construct used

**Information participation:** Information participation refers to the extent to which partners engage jointly in planning and goal setting (Mohr and Spekman 1994). Supply chain partners must first commit to providing better and more accurate information and forecasts in order to allow them to plan their available capacity more effectively.

**Information sharing:** Information sharing in the supply chain is the sharing of knowledge among partners to serve downstream customers effectively and efficiently. This knowledge includes information on the production status and the planning process, but also on changes in the business environment and the goals of the companies. More specifically, information needs to be shared at different levels. While operational integration is geared towards transaction efficiency improvements, integration at the strategic level requires shared or matching objectives (Lamming, Caldwell and Harrison, 2004).

**Information quality:** The literature describes Information quality as an important indicator of the clarity and usefulness of the information (Sum, Yang and Quek 1995, McGowan 1998). It is measured by the degree to which the information shared between supply chain partners meets the needs of the different partners (Petersen 1999). Researchers have identified important dimensions of Information quality. Neumann and Segev (1979), for instance, described high quality information as being accurate, frequently exchanged, recent and containing the appropriate content. Bailey and Pearson (1983) also described several dimensions of information quality as accuracy, timeliness, precision, reliability, currentness and completeness.

**Interdependence:** Interdependence exists when one actor does not entirely control all the conditions necessary for achievement of an action or a desired outcome (Pfeffer 1988). Resource dependency theory provides the major organizational view regarding power and management in strategic alliances. According to this view, firms are seen as interdependent entities seeking to manage uncertainty affecting them (Pfeffer 1988). These interdependencies create patterns of dependencies among the firms, a situation in which firms that own or control valuable, scarce resources hold power over firms seeking those resources to the extent that the dependency is not mutual. Firms lacking control of scarce resources can manage the resulting uncertainty through strategic alliances (Pfeffer and Salancik 1978).

**Market dynamics:** Supply chain dynamics is defined in the literature as the unpredictable changes in products, technologies and demand for products in the market (Miller and Friesen, 1983, Zhou et al. 2007). As supply chain dynamics increase, information processing capacity needs to be increased in order to achieve superior firm performance. Fisher (1997) for instance suggests that supply chains facing a different level of supply chain dynamics should use different supply chain practices.

**Relationship phase:** Relationship Phase (based on Jap and Anderson (2007), Jap (2001) and Jap and Ganesan (2000))

Relationships typically evolve through a number of phases over time. Which of the following best describes your firm's *current* relationship with X? (Check only one)

1. Exploration—Both firms are discovering and testing the goal compatibility, integrity, and performance of the other as well as potential obligations, benefits, and burdens involved with working together on a long-term basis.
2. Buildup—Both firms are receiving increasing benefits from the relationship and a level of trust and satisfaction has been developed such that they are more willing to become committed to the relationship on a long-term basis.
3. Maturity—Both firms have an on-going, long-term relationship in which both are receiving acceptable levels of satisfaction and benefits from the relationship.
4. Decline—One or both members have begun to experience dissatisfaction and is contemplating relationship termination, considering alternative manufacturers or customers, and is beginning to communicate an intent to end the relationship.
5. Deterioration—The firms have begun to negotiate terms for ending the relationship and/or are currently in the process of dissolving the relationship.

**Trust:** Drawing on the literature in social psychology and marketing, trust can be defined as the perceived credibility and benevolence of the partner in the relationship (Geyskens, Steenkamp and Kumar 1998). Based on this definition, trust can be described by two dimensions. The first dimension focuses on the objective credibility of the partner in the buyer-supplier relationship and the expectancy that the partner's word or written statement can be relied on. The second dimension, benevolence or goodwill, is the extent to which one partner is genuinely interested in the other partner's welfare and is motivated to seek joint gains (Johnston et al. 2008). As mentioned by Sako (1992) this second dimension, which is also called goodwill trust (Sako 1992), is particularly interesting in long-term buyer-supplier relationships and is responsible for creating a relational culture (Ireland and Webb 2007).

**Part III:**  
**Conclusions**



# Chapter 7:

## Contributions to the literature and conclusions

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In this last chapter of the doctoral dissertation, we discuss how our findings contribute to and advance the literature on strategic alliances and supply chain integration. More specifically, we discuss how our research contributes to research on the link between integration and performance, the literature on contingencies in the supply chain and work on the life-cycle theory of strategic alliances. Furthermore, we highlight the methodological contributions and the managerial implications. We also identify some directions for future research through the lens of our theoretical framework. Finally, we discuss the contributions and limitations of the methodologies used.

Keywords: integration-performance link, contingency thinking, life-cycle theory

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### 7.1 Introduction

Various integration concepts have received attention from the operations and supply chain management research and practice in recent years. This dissertation focuses on interorganizational integration and its broader concept of strategic alliances. Strategic alliances are defined as long-term cooperative relationships designed to increase the strategic operating capabilities of two individual firms. For this dissertation, we focus on strategic alliances that include some components of supply chain integration<sup>2</sup>. Obviously, strategic alliances do not always include supply chain integration and may also include other integration practices on a

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<sup>2</sup> Supply chain integration is the operational and tactical integration of processes and routines of acquiring and sharing information with a supply chain partner and the practices and procedures in place to handle this information and to support the physical flow (Swink et al. 2007, Carr and Pearson 1999).

more strategic level or in other functional domains. As such, we focus on a specific kind of alliances: alliances with supply chain integration.

This dissertation has three main objectives. The first is to assess the predictive value of behavioural characteristics of a strategic alliance on the operational performance. The second objective is to broaden our understanding of the contextual factors of integrating the information flow, including behavioural characteristics. Finally, the third objective is to look at the dynamics of strategic alliances by understanding how transformational processes impact performance and how these alliances develop over time.

Based on a mixed-method design, we conducted four empirical studies to analyse these research questions. Three studies were conducted using perceptual data and are confirmatory in nature, while the fourth study is based on a case study design. These cases help us to answer some of the ‘why’ and ‘how’ questions that were raised from the previous three studies. It also helps to translate our findings to a more practical setting.

## **7.2 Theoretical contributions**

### **7.2.1 Contribution to the supply chain integration-performance link literature**

Overall, we can state that there is a positive relationship between integration and performance. However, most of the studies in previous research reported rather weak links between integration and performance (e.g. Vereecke and Muylle 2006, Swink et al. 2006) and some conclude that integration is no guarantee for success (e.g. Holweg et al. 2005).

In addition, previous research was not always consistent in linking supply chain integration, operational performance, and financial performance. While some studies report a direct link between supply chain integration and financial performance (e.g. Frohlich and Westbrook 2001), others showed a mediating role for operational performance in linking integration to business performance (e.g. Rosenzweig et al. 2003). Moreover, the current literature is not clear in



whether the relationship between supply chain integration and financial performance is direct or indirect.

Our studies explain some of these previous findings. Study 1 (chapter 3), for instance, shows that the effect of integration practices on performance is moderated by behavioural characteristics, such as alliance attributes (trust, dependence and coordination), alliance management (leadership and process thinking) and communication behaviour (information sharing, information participation, and information quality). More specifically, the data shows that alliance attributes have a positive effect on both cost and flexibility, while alliance management and communication behaviour have a positive effect on cost and flexibility respectively. As such, also behavioural characteristics should be taken into consideration when assessing the impact of supply chain integration practices on performance. Study 2 (chapter 4) and study 4 (chapter 5) also confirm the importance of these behavioural characteristics. Study 2 shows that the level of performance positively co-varies with trust and interdependence. Finally, study 4, based on case studies, confirms this link and shows that trust is a necessity before starting advanced supply chain integration practices.

Another plausible explanation for the fact that many studies found only a weak link between integration practices and performance is the measure of integration (see chapter 5). While most studies are just measuring the level of integration practices between a company and its key suppliers or customers (with questions like: how much are you integrated?), this might not always reflect how capable an organization is to perform and implement these integration activities. As such, measuring just the level of integration might not give us a complete picture of how well an organization succeeds in these integration practices. Therefore, based on the strategy literature (Teece et al. 1997, Teece 2007), we proposed to measure integration not just as the level of integration, but as a dynamic capability, which includes sensing, seizing, and transforming activities. As such, we claim that an integration capability can be reflected by sensing activities - or activities related to gathering information from the other company, seizing activities - or procedures in place that help companies to detect current and/or future changes in the physical flow, and transformation activities - or past action plans concerning integration activities telling us how much experience the organization has in these types of integration activities and how much effort it puts in it. Based on a co-alignment model, we tested this notion

of integration capability in a supplier integration setting (i.e. in an alliance of a manufacturer with a supplier) and found that this representation fitted the data better than a direct-effect model (i.e. as previously measured). We found evidence for the notion of integration capability as a dynamic capability, as defined by the strategic management literature. Moreover, we showed that integration capability, reflected by sensing, seizing, and transforming activities, has a significant impact on operational performance and financial performance. In other words, we confirmed the link between a supply chain integration capability and performance. Furthermore, we showed that operational performance mediates the impact of integration on financial performance. Our case studies (chapter 6) confirmed this dynamic nature of strategic alliances. The case studies showed that a strategic alliance will be successful if the partners are constantly working on the alliance or in other words when partners keep transforming the alliance.

In summary, this dissertation adds to the supply chain integration-performance link by (1) demonstrating the moderating effect of behavioural characteristics, (2) highlighting the importance of measuring integration as a dynamic process which requires continuous interaction and learning between the parties, and (3) confirming the mediating role of operational performance measures.

Our studies, with the exception of study 2, are limited to measuring operational performance in terms of cost and flexibility. Future research might also include other operational performance measures including quality and delivery.

### **7.2.2 Contribution to the literature on contingencies in supply chain management**

Fisher (1997) describes how contextual factors influence supply chain integration practices. Based on these contextual factors such as demand fluctuation and supply chain dynamics, he describes two types of supply chains: (1) functional supply chains in which lean and cost efficient processes are crucial and (2) innovative supply chains in which the process of matching supply and demand is very important. Moreover, the literature shows that managers should choose a supply chain strategy and integration activities by taking into account contextual

factors. The second study of our dissertation (chapter 4) is based on this contingency thinking and examines the impact of contextual factors such as supply chain dynamics and competitive manufacturing strategy on supply chain information flow strategy, which is an important aspect of supply chain integration.

Despite the general idea that supply chain integration is always beneficial (e.g. Currie 2000), the findings of study 2 suggest that a universal approach to inter-firm information flows does not necessarily improve communication. This finding is also supported by Harland et al. (2007), who suggest that managers should be smarter in their IT integration initiatives. One example involves promoting IT supply chain applications in all circumstances. While more advanced information flow strategies seem to pay off, this might not be the optimal strategy for every strategic alliance. Study 2 shows for instance that strategic alliances are more likely to invest in IT supply chain applications in more dynamic environments and in environments with higher levels of interdependence among partners. Consequently, these investments in IT should be in line with the overall integration strategy, the company's product portfolio and the supply chain configuration (Silveira et al. 2004). Moreover, also softer, less technological characteristics should be taken into consideration. As such, this study contributes to the idea of contingency thinking in managing the supply chain. Also study 1 (chapter 3) confirms this contingency thinking: reducing costs (i.e. costs benefits) requires an alliance with a different set of behavioural characteristics than an alliance focusing on improving flexibility (i.e. service benefits).

In general, this dissertation adds to the literature of contingency thinking in the supply chain by (1) pointing out that not all strategic alliances improve performance by using IT SC applications and (2) demonstrating the different supply chain strategies require different sets of behavioural characteristics.

Since supply chain integration is a complex matter, other contingencies might play as well. Future research might for instance look at the impact of uncertainty or supply chain complexity on supply chain integration.

### **7.2.3 Contribution to a life-cycle theory of strategic alliances**

The literature describes two theories of alliance development: DSO (Dwyer et al. 1987) and RV (Ring and Van de Ven 1994). Each of these theories has considerably impacted research on strategic alliances. The first framework has been developed by Dwyer et al. (1987). They describe a buyer-supplier relationship as passing through a fairly rigid sequence of stages. Furthermore, they describe the behavioural properties of this relationship in each stage. Ring and Van de Ven (1994), on the other hand, proposed a more general theory of interorganizational relationships. They described this as a cyclical process in which each step is repeated in each cycle. Although there are a lot of similarities between both theories, there are some differences in explaining some of the ‘why’ and ‘how’ questions of these interorganizational developments. To clarify some of these questions, we collected data on the development of 5 supplier alliances (chapter 6). These cases show that operational integration practices are embedded in a more complex set of interactions, which also include behavioural characteristics and other non-operational integration practices. The cases show a clear pattern of first building trust and then creating interdependence by implementing operational integration activities, which is in most cases followed by relational and sometimes also financial integration activities. The motivation to start operational integration activities can be a supplier reduction program, the need to improve operational performance, or an accident that requires risk assessment. Furthermore, risk assessment might also trigger relational integration. Finally, partners can also decide to integrate financially. Our cases show that this is done for core products with a certain risk factor such as price fluctuations or supply uncertainty.

Both study 3 and study 4 show the necessity to constantly start and conduct new projects with partners in the supply chain. Study 3 confirms that new action plans (i.e. transformation actions) are an important aspect of integration. In addition, study 4 shows some real life examples of companies constantly launching new integration initiatives. This will help the partners to keep focused and to continuously invest in the alliance.

In summary, we added to a life-cycle theory of strategic alliances by (1) demonstrating how alliances develop over time, (2) showing the importance of transformational actions and learning in strategic alliances and (3) investigating the triggers for moving a buy-sell relationship towards a strategic alliance.

Since study 4 only looked at successful strategic alliances or at buy-sell relationships that succeeded in developing toward the maturity phase, we have no information on the declining phase or at strategic alliances that failed to reach this maturity phase. Future research might look at the declining phase or the reasons for not moving to a higher integration phase.

## **7.3 Methodological contribution**

In addition to making theoretical contributions, this doctoral dissertation also makes some methodological contributions.

### **7.3.1 Contribution to the dynamic capability literature**

Helfat et al. (2007) suggested that relationship capability as discussed by Dyer and Singh (1998) can be viewed as a dynamic capability, which purposefully creates, extends, or modifies the firm's resource base, augmented to include the resources of its alliance partner. Similarly, researchers (e.g. Doz and Shuen 1990, Mody 1993) have pointed out that collaborations and partnerships can be a vehicle for new organizational learning, helping firms to recognize dysfunctional routines and prevent strategic blind spots (Teece et al. 1997).

In paper 3 (chapter 5), we tested this notion of a supplier integration capability as a dynamic capability as described by Teece et al. (1997) and Teece (2007). More specifically, we used the framework of sensing, seizing, and transforming (Teece 2007) to describe this dynamic capability. Although there is much research on dynamic capabilities in the strategic management literature, empirical tests to support this notion of dynamic capabilities are scarce. Our study is one of the first attempts in doing so and provides a methodology for measuring a dynamic

capability. Furthermore, study 4 (chapter 6) confirmed this need for transformation to continue the strategic alliance.

### **7.3.2 Contribution to the collection of dyadic data**

The vast majority of supply chain research being published today in leading journals (and also our first studies) still rely on a single respondent, capturing the response of only one firm in the supply chain. The common criticism on this approach is that measures obtained from one firm in a buyer-supplier dyad do not afford valid tests of dyadic relationships. Explicit in the definition of a supply chain is the inclusion of multiple processes which are often managed by different managers in different firms (Handfield and Nichols, 1999). This definition suggests that the traditional and still predominant single-respondent designs used to capture data that crosses departmental, functional, and organizational boundaries within a supply chain are of questionable validity. In study 4 (chapter 6), we focus on this limitation by collecting data from both buyers and suppliers in a buyer-supplier relationship. Measures of inter-organizational relations were obtained via key informants from both sides of buyer-supplier dyads. The methodology employed in this study illustrates an approach to obtain a more holistic research design in a supply chain management context. Future research should focus on the buyer's as well as the supplier's perceptions and motivations for strategic alliances and supply chain integration.

## **7.4 Contribution to practice**

This dissertation reflects the idea that supply chain integration choices are an important addition to the traditional manufacturing strategy choices (Rozenzweig et al. 2003, Frohlich and Westbrook, 2001). Without supply chain integration, supply chain partners will experience differences in objectives and performance metrics, disagreements on items such as inventory ownership (who is responsible for what in the supply chain), and a general unwillingness to collaborate (Parker and Anderson, 2002). Hence, manufacturing managers must become more

adept at managing external supply chain relationships and must make deliberate investments in resources and time that build integrative capabilities.

This dissertation also shows that not all supply chain integration practices lead to performance improvements. Whether certain practices lead to improved performance depends on contextual factors and behavioural factors. IT supply chain investments are for instance more valuable in environments with high levels of innovation.

It is important to know that strategic alliances might create both cost and service benefits for the manufacturer. Depending on the benefits managers want to gain, different sets of behavioural characteristics and resources are required. In other words, to achieve the full set of benefits of a strategic alliance, managers must focus on multiple behavioural characteristics such as alliance attributes (trust, interdependence and coordination), communication behaviour and alliance management (leadership and process thinking). In addition, in the increasingly dynamic environment of today, firms need to be able to adapt quickly to sustain competitive advantages. Forward-looking managers who are willing to invest in skills and practices for supplier integration can take advantage of complementarities by developing a Supplier Integration Capability. This requires investing in different sub-capabilities to (1) grasp information from the partner, (2) procedures to translate this information into understandable information for the company and (3) action programs to adapt to the new situation.

Furthermore, the benefits of supply chain integration are not always directly visible or present. While IT supply chain applications for instance might often be successful in more traditional relationships, companies are often disappointed by the limited cost/benefit ratio of IT supply chain applications in strategic alliances. Far too many companies hope to replace traditional communication systems such as face-to-face contact and phone calls, by standardized IT supply chain applications. Since strategic alliances still build on trust, personal contact cannot be replaced by these IT supply chain applications.

Furthermore, our study shows that managers can use both formal and informal governance mechanisms for managing these supply chain relationships. Our analysis show that these are complements rather than substitutes and should both be present to create successful strategic alliances.

## **7.5 Limitations and Future research**

There are also a number of limitations and avenues for future research. For more in-depth discussions on these limitations and opportunities, we refer to the limitations section in each essay. Here, we briefly discuss the main limitations and opportunities of the dissertation across the four empirical studies.

### **7.5.1 Methodological limitations and future research**

#### **7.5.1.1 Survey-data**

A first limitation of this dissertation is that the studies mainly rely on survey data (study 1 to 3). Since survey data relies on a single instrument, this might create issues of common method bias (Podsakoff et al. 2003). Furthermore, consistency motives, social desirability, implicit theories, illusory correlations, leniency, acquiescence, and mood states all may have biased individuals' responses (Podsakoff et al. 2003). To limit common method bias (CMB) and biased responses, we took great care in setting up our questionnaires and we statistically controlled for method effects in study 3 (chapter 5) (Podsakoff et al. 2003). Furthermore, we have chosen a mixed-method design, which also includes case studies to further elaborate and fine grain our findings in a case study setting.

#### **7.5.1.2 Cross-sectional data**

The cross-sectional character of studies 1 to 3 precludes us from drawing causal inferences. As such, many of the relationships we found may also have been reverse-ordered. Although the models we tested are theoretically sound and are consistent with our case-study research, future research should test our models using longitudinal designs. Our retrospective case studies are a first step in limiting this bias.



## 7.5.2 Theoretical limitations and future research

This doctoral research is limited to strategic alliances of manufacturing firms. Service contexts are characterized by more ambiguity, uncertainty and variability and the use of different communication media (Ambrose et al. 2008), which may impact integration strategies. As such, future research might look at whether our findings can be generalized towards service companies.

A second avenue for further research is to investigate whether our findings of strategic alliances in a supply chain context can be generalized towards other strategic alliances such as for instance joint ventures or R&D consortia.

A third opportunity for further research comes from the fact that we measured supplier integration capability and its impact on performance as seen from the buyer's perspective. We did not include the supplier's perspective. Future research can address this shortcoming by collecting dyadic data. Another extension of the research is to look into contingencies in the framework of supplier integration capability. Manufacturing strategy, market conditions and internationalization are some examples of contingencies that should be tested in the future. Finally, we investigated a dynamic capability by using non-longitudinal data. This data does not enable us to fully capture the dynamic nature of supplier integration because of the 'snap-shot' nature of the data. Future research could verify that firms with SIC sustain their performance across environments. However, we set a first step towards capturing the dynamic nature by using the foundations of Teece (2007) for dynamic capabilities, in which integration transforming measures the evolution or dynamic nature of supplier integration.

Last but not least, we believe that future research efforts must be dedicated to the formation of management strategies and the formation of skills that encourage the continued growth and maintenance of the alliance.