

# A Critical Discussion on the Theoretical and Methodological Advancements in Supply Chain Integration Research

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*Summary:*  
*Integration is one of the central themes in supply chain management research. This paper explores and discusses the constructs and methods used in empirical research with respect to supply chain integration. A large part of the empirical research on integration is characterized by the use of constructs and scales that measure limited, partial aspects of integration. Furthermore, it appears that contextual factors are hardly addressed. This paper develops a broader construct of supply chain integration and sketches the advantages of a multi-case study approach as an alternative methodology to survey research to develop our knowledge of supply chain integration and its antecedents.*

*Keywords:*  
*Supply Chain Integration, Supply Chain Context, Methodology*

# 1 Introduction

Over the past decade, one of the main themes in the SC literature has been integration as a key factor in achieving improvements (e.g. Tan et al., 1999; Romano, 2003). The general idea is that integrative practices and a high level of integration have a positive impact on corporate and supply chain performance.

Recent empirical work (Frohlich & Westbrook, 2001; Vickery et al., 2003; Childerhouse & Towill, 2003) shows convincing evidence for the relationship between integration and performance. Although some of these studies might be criticized for using a limited description of integration, we think that there are more fundamental problems in both the empirical and the theoretical work on integration. More specifically, Ho et al. (2002) formulate doubts with respect to the relationship between integration and performance in these empirical studies. They state that there is little consistency about the basic definition and content of the constructs used in these studies (Ho et al., 2002: 4415). In future research, we thus need to come up with sound constructs and adequate methodologies that help us to understand the relationship between integrative practices and supply chain performance.

From a methodological point of view, the majority of the empirical studies seem to be either single cases (e.g. Lee et al., 1993; Hewitt, 1997; Childerhouse et al., 2002) or survey-based research (e.g. Frohlich & Westbrook, 2001; Vickery et al., 2003; Tan et al., 1999). Typically, the first type of research describes and analyzes one dyad or single link, is often practitioner-oriented, and shows the advantages of (the introduction of) a new integrative practice. Survey-based research on integration hardly considers single links or relationships. In this type of research, integrative practices and the relationship with performance are studied on a high level of aggregation. Aggregated constructs are used to measure the integrative practices conducted by e.g. a buying company in the links with all their suppliers.

Overall, case studies make it harder to generalize findings, specifically if there is no clear theoretical framework supporting these case studies (Yin, 2003; Meredith, 1998). As opposed to case studies, the surveys incorporate limited aspects of integration and fail to grasp what actually happens in supply chain relationships.

A last critical issue is that much of the empirical work fails to address the context (Ho et al., 2002) or business conditions (Van der Vaart & Van Donk, 2003a; 2003b). Our paper will explain how business conditions and context can be incorporated into a theoretical framework that explains the level of integration in a supply relationship using a broad construct of integration.

The main aim of this paper is to discuss the theoretical framework and the constructs used. Based on an assessment of empirical research, we will present a theoretical model that combines context, level of focus, supply chain integration, and performance. However, we also pay attention to the research methods used to

measure integrative practices and discuss our experiences in a recent empirical study using a multi-case study setting. We argue that multi-case studies can help to bridge the gap between single case studies and surveys, and is an appropriate means to develop knowledge in the field of supply chain integration in its current stage of development.

This paper is organized into five sections. In the next section we will evaluate empirical work on integrative practices in supply chains. Then, we will present an alternative framework that addresses the shortcomings in these empirical studies. The fourth section pays attention to the methodological problems in measuring the framework presented. The last section summarizes our conclusions.

## **2 Evaluation of Supply Chain Integration Research**

This section will review the empirical work on supply chain integration. The main point of this section is not to give an overview of all literature in the field, but rather to focus on the constructs used in measuring supply chain integration and its antecedents. More specifically, we address three points of concern regarding the current state of empirical research in the area of supply chain integration. First, we pay attention to the limited scope of the constructs used in measuring supply chain integration. Second, we discuss the role of contextual factors in current empirical work. As a third point, we advocate the measurement of supply chain integration at the level of dyads, instead of measurement at higher aggregated levels.

### **2.1 Limited Scope of Integration**

Supply chain management as a discipline has been inspired by many fields: materials management, quality, industrial markets, purchasing, and logistics. At the core of SCM lies the idea of collaboration between buyer and supplier or the building of a relationship (Ho et al., 2002; Chen & Paulraj, 2004). It is not surprising that integration has been seen as one of the main drivers in establishing good supply chain management. Stevens (1989) was among the first to stress the strategic importance of integration. Other researchers (e.g. New, 1996) mention it as one of the core elements of SCM, describe different types of integration (e.g. Tan, 2001), pay attention to integration of key business processes (e.g. Ho et al., 2002), or describe it in terms of integrating traditional logistical functions (Gustin et al., 1995). Integration can also be discussed as removing barriers (or boundaries) between organizations (Naylor et al., 1999; Romano, 2003).

It is surprising to note that, although the importance of integration is broadly advocated and different areas are mentioned in conceptual contributions, the measures or constructs used (especially in surveys) are rather narrow. The surveys

presented in Shin et al. (2000), Carr & Pearson (2002), and Prahinski & Benton (2003) focus on relational and/or strategic issues. Examples of factors that are considered are strategic purchasing, supplier evaluation systems, buyer-supplier relationships, supply management orientation, and supplier development. The aim of another group of surveys is to find out how operational practices help in improving performance in the supply chain. Here, the studies are mostly limited to a few number of aspects mostly related to the flow of goods and information only. Frohlich & Westbrook (2001) measure integration by selecting eight aspects in the two areas that relate to the operational aspects of information and physical flow. Vickery et al. (2003) stress the importance of integrative information technologies as a prime dimension in integration.

Most surprisingly, given the large amount of elements distinguished within supply chain integration research, Chen & Paulraj (2004) built in their broad study a construct of logistics integration around only six items related to how integration is perceived, that is, focused on the flow of goods only. While each of the above-mentioned studies helps in understanding the relationship practices-performance, little has been done at comparing practices (Ho et al., 2002).

## **2.2 Context and Supply Chain Integration**

While the majority of empirical studies focus their attention on the relationship between supply chain management practices or supply chain integration and (improved) performance, Ho et al. (2002) state that these practices are embedded in the context that supports or restricts the use of certain supply chain practices. One of their examples to show that context is relevant is the influence of demand characteristics on the type of practices employed: an issue addressed by Fisher (1997), Mason-Jones & Towill (1998) and Childerhouse & Towill (2002). Ramdas & Spekman (2000) find differences in supply chain practices in functional products supply chains as opposed to those in innovative products chains. Hill & Scudder (2002) link the size of a company to its use of EDI. Van Donk & van der Vaart (2005) show that the process capabilities of a process industry are an important context factor that can pose considerable limitations for integrative practices with buyers. This stream of research partly answers the remark by Frohlich & Westbrook (2001: 185): “Our knowledge is relatively weak concerning which forms of integration manufacturers use to link up with suppliers and customers.” Still, the influence of context is not very well investigated.

Uncertainty seems to be one of the most important aspects of the context of supply chain management and a number of studies pay attention to it. Much work has been done on the “bull-whip” effect in a more model-based and limited context (e.g. Lee et al., 1997; DeJonckheere et al., 2003). Others like Childerhouse & Towill (2002) see the importance of uncertainty for integration but regard reducing uncertainty as an equivalent of integration: “An integrated supply chain has

minimal uncertainties...” (Ibidem, 2002: 3503). Still, we feel that context and its importance is not valued enough. This is illustrated by the relatively poor attention Chen & Paulraj (2004) give to context. While addressing almost all aspects of supply chain management and developing scales for each concept, context is represented in their research framework by uncertainty, supply network structure (power) and competitive factors.

### **2.3 Supply Chain Integration as a Dyadic Concept**

Supply chain management and the associated idea of seamless coordinated flows of materials and information has aroused such enthusiasm in the literature that one of the often-stated beliefs is that companies no longer compete but that supply chains or supply networks do. This might be true for a number of specific chains, such as the automotive industry where all different partners in a chain are totally attuned. In that specific context, one often encounters supplying plants that deliver all production to one final assembly automotive line. As a result, different supply chains in the automotive industry compete. However, in other industries, suppliers deliver to different (probably competing) companies and have to balance their capacity to be able to deliver to different customers. Often, they will be part of several if not numerous supply chain networks. As a result, we need research on the supply relationship between two companies: a buyer and a supplier. In most cases we do not directly need insight into the whole reverse and forward chain. This might even apply to the automotive industry where agreements are made on the buyer-supplier link as well. For each dyad in the chain, circumstances can be quite different, resulting in link-specific arrangements.

Another argument for focusing on one company and the relationship with either a buyer or a supplier comes from New (1996), who points out the problem of dividing the benefits of an integrated supply chain. He raises the question on whether the end-user will benefit from lower costs or that one of the chain members will raise his profits. The issue of who benefits is even more interesting in the case of two competing customers of one supplier; here one competitor might profit from improved supply chain management practices with the other competitor. Once again, this type of problem needs to be resolved in the dyad of supplier and buyer.

Some recent research explicitly pays attention to the dyadic nature of supply chain management (e.g. Johnston et al., 2004). For a summary of related research we refer to Chen & Paulraj (2004). We strongly believe that supply chain management practices are formed and managed in the one-to-one relationship between a supplier and a buyer. A long-term relationship, which is often seen as part of supply chain management, can only develop and prosper if both the supplier and buyer profit from the relationship. Apparently, a supplier will more compete with other similar suppliers than compete with the competitors of his buyer.

### 3 Antecedents of Supply Chain Integration

This section will elaborate on the basic building blocks for conceptualizing and measuring integration and the main factors influencing the type and level of integration in a supply link. So far, we have paid little attention to performance, as most research is quite clear on the relationship between integration and performance. In our proposed framework, we see performance as the ultimate outcome (see Figure 1). It should be emphasized that measuring performance is not an easy task as well. With respect to supply chain performance, a large number of performance measures have been used in the literature, stressing that performance is a multi-dimensional concept itself. For further discussion we refer to the specialized performance measurement literature. In the development of our framework we explicitly do not address the relational aspects as power and trust. The main reason is that our intention is to examine the influence of structural factors related to technology and market structure on supply chain integration and integrative practices.

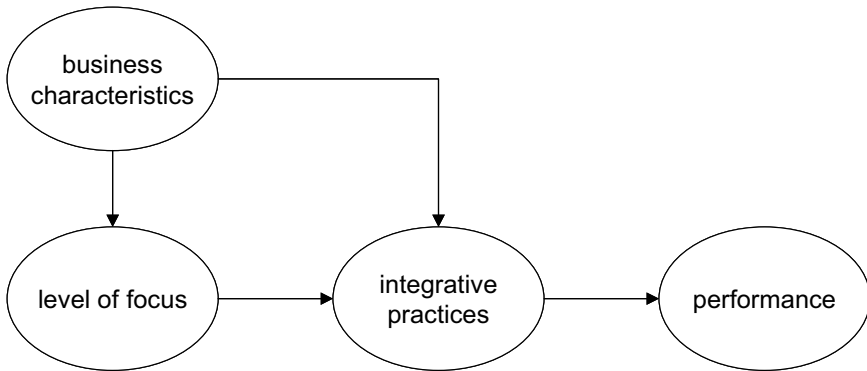


Figure 1: Conceptual Framework

Integrative practices depend on two factors: business characteristics and the level of focus. Business characteristics (context according to Ho et al., 2002) are related to the nature of the production processes and the nature of the products and markets. These factors influence the need for integrative practices. For example, highly innovative products require a high level of attuning between buyer and supplier (Ramdas & Spekman, 2000). The level of focus relates to how the above factors are combined into shaping the production system and the relationship with buyers/suppliers. In principle, two extreme options exist for the level of focus. Resources are shared for all products and all buyers, or resources are singled out to supply products for one buyer. It might be clear that the level of focus determines to some degree the limitations and possibilities for integrative practices. Each part of Figure 1 will be further elaborated in the following subsections.

### 3.1 Business Characteristics

In contrast to uncertainty, most other business characteristics have been relatively ignored. Of course, a number of context factors have been mentioned: e.g. power, trust, network structure, and knowledge. Another approach is to look more at the structural factors as Ramdas & Spekman (2000) do. Building on Porter (1985), they pay attention to what drives supply chain performance by distinguishing between basically two types of chains: innovative product versus functional product supply chains. The main factors taken into account as business characteristics are: availability of substitutes (limited vs. large), changes in market conditions (rapid vs. slow), changes in technology (rapid vs. slow), market maturity (low vs. high), and product life-cycle length (short vs. long). Other relevant factors that seem to influence both the level of integration and the level of focus are discussed in Van der Vaart & Van Donk (2003a; 2003b). They investigated the influence of order winners (ranking of performance dimensions), the location of the decoupling point (percentage products that are produced using MTO, ATO, MTS), time window for delivery (average, range), batch size (average, range), and the volume-variety ratio (average volume per product). Aitken et al. (2003) investigate the influence of the position in the life cycle of a product and show that products in the early phase of the life cycle need to be treated differently than mature products with respect to the type of SCM.

The above enumeration of characteristics is probably not complete, but in the papers mentioned they provide a good explanation for differences in the type and level of integrative practices. Moreover, the type of industrial sector is probably an important factor as well. For instance, factors like shelf-life constraints and increased consumer attention for safe and environmental-friendly production methods (Van der Vorst & Beulens, 2002) partly explain the focus on transparency and ICT in food supply chains (e.g. Hill & Scudder, 2002). In the automotive industry, the large volumes and relatively stable demand patterns enable lean practices (e.g. Hines et al., 2000), packaging customization and standardization of deliveries (e.g. Van der Vaart & Van Donk, 2003a).

### 3.2 Level of Focus: Shared or Buyer Focus Resources

Since the seminal article of Skinner (1974), focus has been on the agenda in operations management research. The decision to focus a part of the operations is one of the strategic decisions to be taken within manufacturing strategy. The basic idea in most contributions is that a focused operation (either manufacturing or supply chain) should be matched to the market requirements. Although the strategic nature of supply chain management has been stressed from Stevens' contribution (1989) onwards, supply chain focus has been relatively ignored (Aitken et al., 2003).

Griffiths & Margetts (2000) and Griffiths et al. (2000) fill that gap by introducing a new form of focus: customer or buyer focus, aimed at supply chain integration. Buyer focus can be understood as singling out resources for the purpose of delivering products for one buyer. In that case, integrative practices can easily be achieved along a broad scope and at a high level (see next subsection). While buyer focus enables integrative practices, shared resources can be seen as a barrier. A shared network resource is a common-capacity source in two or more supply chains or networks (see also Hoekstra & Romme, 1992). Shared network resources are resources that are used by a supplier in the network for more than one buyer. Here, buyers competing for the resources seem to be one of the main barriers in achieving integration. This is especially true if the capacity of these resources is scarce (see Van Donk & Van der Vaart, 2005). These two extreme situations that are further explored in Van der Vaart & Van Donk (2004) are part of a continuum that is labeled as “Level of focus.” One of the intermediate positions is e.g. the singling out of assembly operations that are performed for one customer, while the core activities are still performed using the shared network resources.

The level of focus will be chosen based on market characteristics and business conditions (as described above) and technology. As with focus in general, this is a strategic decision, that is to some extent restricted by the typical technology employed in a certain industrial sector. Level of focus is also important as it either enables or restricts the possibilities for integrative practices in supplying buyers.

### **3.3 Supply Chain Integration**

Based on the literature, we distinguish three aspects of integration: direction, scope and level. These three aspects already reflect our aim to develop a rich and multi-dimensional construct of integration. We elaborate that concept further by distinguishing five dimensions of the scope of integration.

A first natural distinction is the direction of integration: downstream with suppliers, upstream with customers. This distinction goes back to the separation of inbound and outbound logistics, materials management, and physical distribution or purchasing and distribution. This distinction is widely accepted and documented in the literature (e.g. New, 1996; Tan, 2001; Frohlich & Westbrook, 2001). Integration in supply management can also be external (with other organizations) or internal (within one company). We will limit ourselves to external integration, because we consider that to be the innovative/new element in the philosophy of supply chain management.

A second aspect of integration is the number of different areas in which joint activities are developed. This is labeled as the scope of integration. Based on our critical comments on the narrow scope and level of integration as expressed in the field, we do not restrict ourselves to a few practices, but measure integration



across a larger number of possible areas or dimensions from the fields of production management, complemented with concepts from the supply chain theory and logistics management as being among the key antecedent disciplines of supply chain research according to Croom et al. (2000). In line with recent work (Van Donk, 2003; Childerhouse & Towill, 2002; Childerhouse et al., 2002) we distinguish four supply dimensions to which we add product development as a fifth one (based on e.g. Lee et al., 1993; Davis, 1993):

- **Physical Flow:** typical integrative practices are Vendor Managed Inventories (VMI), packaging customization and common equipment or containers (see also Frohlich & Westbrook, 2001).
- **Planning & Control:** examples are joint planning or forecasting, Multi-Level-Supply-Control (Van der Vlist et al. (1997) and rolling plans with quantity commitment (Tsay, 1999) (instead of discrete ordering). Advanced practices involve an orchestrated supply chain.
- **Organization:** this dimension refers to the type of relationship between buyer and supplier (e.g. partnership). Concrete examples are JIT II (i.e. application of JIT concepts to the purchasing function by having a representative of the supplier locate at the buying organization's facility; see Stock & Lambert, 2001: 294), specific account managers, dedicated planners for one buyer, and the creation of quasi-firms (Lamming, 1993).
- **Flow of information:** integrative practices with respect to information and communication technology (ICT). Examples are EDI and bar coding, the use of MRP/ERP (Vickery et al., 2003).
- **Product development:** the level of integrative practices with respect to product development can be measured by information shared on technical details, the mutual involvement in product development, and process improvements (e.g. Davis, 1993; Lee et al., 1993).

The third aspect of integration is the Level of Integration. This can be described (in line with Frohlich & Westbrook, 2001) as to what extent integrative activities within one dimension are developed. This can be measured as the number of activities within one dimension, but the level is also higher if more advanced and demanding practices are used. The level of integration applies to each of the areas presented above. As an example, it is clear that a rather high level of integration is reached in planning and control in the case of Multi-Level Supply Control. A low level of integration in this field might be to only inform your supplier about your promotional actions.

## **4 Methodological Issues**

### **4.1 Surveys and Single Case Studies**

While we already pointed out the limited scope of supply chain integration measurements in section 2.1., we have some doubts regarding the way questions are asked. In many surveys respondents are asked to report whether they feel that over a certain period specific practices have grown in importance or not. In most cases this means relying on the perception of respondents instead of relying on real measurements of the effects. The same holds for the effect: the perceived improvement in certain performance measures is measured (e.g. Shin et al., 2000; Vickery et al., 2003; Prahinsky & Benton, 2004).

In general, there is an adverse relationship between the length of a survey (the number of questions and the level of detail asked) and the response rate. When making a survey and sending it out, this puts the researcher in a paradoxical situation. The more you learn from each respondent, the fewer responses one might expect. Still, even with a small number of questions, surveys show a low level of response. Some researchers even state that 15-20% is “normal.” A recent example is given by Bagchi & Skjoett-Larsen (2004) who report less than a 20% response rate even in the home country of the second author. In general, this gives a serious limitation to the validity of the results.

With respect to the case studies performed in literature, there are serious doubts as well. Most cases describe improvements of supply chain management practices and are problem driven. Strangely enough, the literature hardly reports on failures, while the successful improvements are numerous. This raises the question regarding whether cases were selected with the purpose of “theoretical replication” (Eisenhardt, 1989) in mind. Actual analysis, case study protocol and other measures of validity and reliability are hardly discussed. Only a few researchers pay attention to case study methodology. Childerhouse & Towill (2003) analyze 32 cases with the same instrument and take care of triangulation of the data, showing their research protocol, etc. However, little can be said about the selection of their sample, which is generally considered to be critical in case study research (e.g. Eisenhardt, 1989). Aitken et al. (2003) take care in the description and analysis of their cases as well.

### **4.2 Multi-Case Approach**

In the introduction we stated that the majority of empirical contributions in supply chain management research falls into one of two categories: survey or single case study. It is not the intention of this contribution to repeat the advantages and disadvantages of both. Meredith (1998) has given a good overview of both methods

in the field of operations management that is applicable for supply chain management research. Although not being a description of research methods themselves, two recent articles by Dennis & Meredith (2000a; 2000b) shed some interesting new light on the use and analysis of case studies. In their study, 19 companies are described using a case study approach that combines quantitative and qualitative data as well as observations. These data are reduced to a limited number of variables that are used to perform a statistical analysis along with a cluster analysis. For the interpretation of the clusters, the additional qualitative findings are beneficial for further explanation and understanding of the findings. Here we see a nice combination of survey and case study approaches.

In the field of supply chain management and integration, many questions relate to why supply chain management in certain circumstances works (or not) and how certain practice work (or not). With respect to integration in supply chain management, our knowledge is still in its infancy and we do not yet fully understand and know the antecedents of integration. Despite all efforts in performing single case studies, more comparison seems needed to further develop supply chain management research. A multi case study approach combines a number of aspects. First, each case can be explored in depth, using a variety of research approaches to enhance triangulation. Second, a multi case study approach can be used to find contrasting situations that are based on theoretical concerns. Most preferable are studies that combine cases that show high levels of integration with cases that have an absence of integration. Such choices of the sample (based on conceptual propositions and theoretical constructs) are advocated by Eisenhardt (1989) to enhance the contribution of case study research. Third, the case study approach enables the links between two companies to really be explored, while looking at their (mutual) integrative practices. Integration should be measured at the level of links and not as an organizational concept.

Recently, we conducted a study along 9 units to investigate the integrative practices between suppliers and their key buyers (Van der Vaart & Van Donk, 2003a; 2003b). We gathered data on business characteristics, the level of focus, and the integrative practices using structured interviews with open questions and observation of the production processes. Each unit was visited twice, which took about one day for each unit to collect data and to check and validate our findings. A combination of qualitative and quantitative data enabled and facilitated cross-case comparison, and on the other hand, interpretation of findings for each case and across cases. In line with Dennis & Meredith (2000a), and as suggested by Voss et al. (2002) we rescaled a number of variables. Given the relatively small number we did not use any statistical tools, as different clusters could be identified without such tools. All in all, we strongly believe that this type of study provides rich research material and profound insights, while the investment in time spent on collecting the data is still affordable. Dennis & Meredith (2000a; 2000b) and Childerhouse & Towill (2003) spent more time on data collection (for each company about one week) and probably have a richer set of data. Within a case study

framework, some additional data collection instruments such as questionnaires for a larger number of employees can be used. This will result in more reliable data, and moreover, specific concepts can be investigated. In a study by Nauta et al. (2002), questionnaires were used to link personality characteristics to bargaining behavior between sales and production departments. These findings could be linked with findings on the process characteristics, demand patterns, etc. from interviews, data files and observations.

## 5 Conclusion

This paper has evaluated the advancements in supply chain integration research. The main criticism on the literature can be summarized into four points:

- Supply chain integration has been conceptualized and measured as a too-limited construct;
- Supply chain integration research pays little attention to contextual factors;
- Supply chain integration is measured as an organizational concept instead of as a dyadic concept;
- The methodology used in supply chain integration research does not sufficiently support the necessary explorative character of research.

We develop a conceptual framework that takes into account business characteristics (context) as a main factor for integrative practices. Integration is sketched as a multi-dimensional phenomenon, while level of focus is seen as an intermediate variable. We advocate a multi-case approach as a sound strategy for the further development of the field.

Further research should extend our framework empirically and conceptually. Testing and applying the framework, adding more variables to it and developing scales to measure its concepts and dimensions are among our priorities.

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