2.3
A Critical Review of Surveys in Supply Chain Integration Research

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Introduction

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

Recent empirical work (Frohlich and Westbrook, 2001; Vickery et al., 2003; Childerhouse and Towill, 2003) shows convincing empirical evidence for the relationship between integration and performance. As the amount of survey-based research in the field is growing, it seems to be appropriate to summarise and evaluate the current situation.

The aim of our paper is to review the survey-based research and to come up with a number of concerns with regard to the empirical survey-based research on the relationship between supply chain integration and performance. Based on those concerns, we investigate what might be the consequences for the theoretical background of the work done so far and for future scientific work.

Our evaluation is based on some initial observations with respect to the published survey research over the last years. A first observation is that it seems that if we aggregate over all surveys on integration, we encounter a large list of different constructs and measurements. If we look at single articles usually only a limited number of variables is included. Another remark is made by Ho et al. (2002), who formulate doubts with respect to the relationship between integration and performance in most survey 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, p. 4415). Sound constructs and adequate methodologies are thus needed

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that help us to understand the relationship between integration and supply chain performance.

A first point of discussion in current research is that a large variety of supply chain management and integration definitions exist, ranging from purchasing type of description to almost transcendent definitions (see Croom et al., 2000; Tan, 2001). A second point that relates to the integration-performance relationships is that there is a great variety of constructs and measurements used: ranging from patterns of behaviour (Johnston et al., 2004) to operational practices (Frohlich and Westbrook, 2001). Mostly, only a small number of variables is included to explore the integration-performance relationship and interaction between variables is often ignored. The concept of supply chain integration is measured both in a broad sense as well as in a limited sense. Another measurement and construct issue is that the level of analysis varies in different studies. Some survey-based research on integration considers single links and relationships (Johnston et al., 2004). Most other papers seem to measure integration or integrative practices and the relationship with performance as an organisational variable, valid for all links with suppliers or buyers. Aggregated constructs are used to measure the integrative practices conducted by for instance a buying company in the links with all its suppliers. All these observations and concerns are more or less ad hoc, and interesting papers have been published recently. A systematic analysis of recent research (also of research published later than the work of Ho et al., 2002) can provide us with an answer with regard to what is the current status of the field and what is required in future research.

Our paper reviews and analyses the current papers that report on survey research. We will evaluate the constructs, dimensions, measurements and scales used for integration. Our analysis will result in an assessment of the current state of survey research in supply chain integration. Moreover, based on the assessment, we develop a framework to measure supply chain integration that aims at more comprehensively covering all of its different dimensions and aspects and taking into account possible interaction effects between its different dimensions. Business conditions and contextual factors are linked to the framework. The ultimate aim is to help guide future research.

The paper is organised as follows. The next section will describe the methodology employed for our review. Then, we will give some general remarks. The main sections of the paper describe and analyse SCM factors, performance, and in the discussion section, their relationship will be analysed. The last section will give our main conclusions.

Methodology

The literature on SCM is growing at a fast rate. For the present paper, we mainly selected papers from *JOM*, which is considered to be the top journal in the field with the highest impact factor. Moreover, this journal specifically focuses on sound methodology and publishes a lot of survey-based research. We added a number of articles from other well-established journals: *Omega*, *IJOPM*, *Interfaces*, *Journal of Business Logistics*, and *IJPR*. In principle, only articles that were published in 2000 or later were considered, with a few exceptions before 2000. We selected those that explicitly investigated the relationship between supply chain integration (integrative practices) and supply chain performance in a survey research design. Out of 26 papers in these journals, we investigated 16 articles for this paper due to time and page limitations. The articles were carefully considered, and for each article, we summarised the hypothesis, the SCM factors, the items (and variables) considered, the sample and industry, the focus (suppliers, buyers and relationships), performance measures and additional remarks to make a comparison across our sample of articles possible. Both authors took independently part in assessing the articles.

In this paper, we restrict the discussion to the external SCM factors. In the selected surveys, internal factors are also included like strategic purchasing (Carr and Pearson, 1999; Chen et al., 2004), internal integration or collaboration (Stank et al., 2001; Droge et al., 2004; Gimenez and Ventura, 2005) and supplier evaluation communication strategy (Prahinski and Benton, 2004).

General descriptions and findings

As might be expected, most of the surveys considered have as their main hypothesis that there is a positive relationship between the level of integration and the performance of the focus company. With respect to SC integration, most researchers choose to look at integration with suppliers and relate that directly or indirectly to the (financial) performance of the focal company. Important factors are supplier development and relationship, strategic purchasing and sourcing, managing or limiting the supply base. There are only a few exceptions. Frohlich and Westbrook (2001) take into consideration both upstream and downstream integration in their contribution. In general, the hypotheses about the relationship between integration and performance are confirmed.

With respect to the focus or population of the surveys it seems that research in the automotive industry is most popular (33% of the surveys). It is also striking that the majority of the response rate (as far as reported) is relatively low (about 30% or lower) with the clear exceptions of Ramdas and Spekman (2000) and De Toni and Nassimbeni (1999), who report respectively 75% and over 60%. In general, low response rates might imply low validity of the outcomes of a survey, specifically if the non-response is biased towards some specific groups of respondents. Most surveys rely on a single respondent, although a number of surveys use multiple respondents within each unit investigated or respondents from two companies to investigate the relationship between these two (e.g., Johnston et al., 2004). A last general remark is that measurement tends to use Likert scales (5,7 or 10 points).

The overall conclusion with respect to the above is that empirical research confirms the relationship between the level of SC integration and performance, but that response rates and choice of respondents and populations limit the validity and generalizability of the results in a number of articles. We will now have a closer look at how integration is actually measured.

SCM factors in survey-based research

Starting point for the current status of survey-based research in SCM literature are the factors used to investigate the relationship between SCM (or SC integration) and performance. To do so, we focus on the factors, constructs and items used in the selected surveys. The second column of Table 2.3.1 shows that a large number of different SCM factors are employed in the surveys. A first group of factors seem to relate to the relationship a firm maintains with its supplier or customer. Examples of these factors are buyer-supplier relationships, closer customer relationships and joint responsibility. The aim of a second group of factors seems to be to measure the mindset of the (buying) firm with respect to their suppliers. Examples are long-term orientation, sourcing policies, flexibility in arrangements and supply management orientation. The last group of SCM factors that can be distinguished are factors that relate to practices or technologies. Examples are operational practices, information practices and integrative information technologies.

If we look at the detailed level of the items or constructs that are used to measure these factors, this grouping seems not sufficient for two related reasons. The first reason is that authors use different items or constructs to measure the same or closely related SCM factors. For

Table 2.3.1 SCM factors and items in SCM research

		SCM items		
Article	**SCM factmor**	**Attitude**	**Pattern**	**Practice**
Carr and Pearson (1999)	Buyer-supplier relationship	X	x	X
Chen et al. (2004)	Limited number of suppliers	x		
	Communication		x	
	Long-term orientation	x		
De Toni and Nassimbeni (1999)	Operational practices			X
	Sourcing policies	x		
Droge et al. (2004)	Supplier development		x	X
	Supplier partnership	x	x	
	Closer customer relationships	x		
Frohlich and Westbrook (2001)	Arcs of integration			X
Gimenez and Ventura (2005)	External integration		x	
Johnston et al. (2004)	Buyer's benevolence (supplier's perception)	x		
	Buyer's dependability (supplier's perception)	x		
	Joint responsibility	x		
	Shared planning	x	x	
	Flexibility in arrangements	x		
Prahinski and Benton (2004)	Buyer-supplier relationship	x	x	
Ramdas and Spekman (2000)	Information practices			X
	Partner selection practices	x		
Salvador et al. (2001)	SC interactions			X
Shin et al. (2000)	Supply management orientation	x		(x)
Scannell et al. (2000)	Supplier development		x	x
	Supplier partnering	x	x	
	JIT purchasing			x
Stank et al. (2001)	External collaboration	(x)	(x)	
Stanley and Wisner (2001)	Cooperative purchasing/supplier relationship		x	(x)
Tan et al. (1999)	Supply base management practices	x	x	(x)
Vickery et al. (2003)	Integrative information technologies			X
	Supply chain integration	x		

instance, both Carr and Pearson (1999) and Prahinski and Benton (2004) examine the relationship between the buyer-supplier relationship and performance. Carr and Pearson only use six items varying from loyalty and frequent face-to-face communication to direct computer links with suppliers. Whereas in Prahinski and Benton (2004, p. 42) buyer-supplier relationship is a second-order factor and defined as "the supplier's perception of the buying firm's behavioural and operational relationship attributes: buying firm's commitment, cooperation and operational linkages". From the 17 items used to measure these attributes, 10 were dropped in the analysis. The remaining 7 factors are all items measuring the perception of the supplier of the attitude of the buyer towards the supplier. Another example can be found if we consider the factors SC integration (Vickery et al., 2003) and external integration (Gimenez and Ventura, 2005). Vickery et al. operationalise SC integration with the items supplier partnering, closer customer relationships and cross functional teams. Gimenez and Ventura use items like informal teamwork, shared information and joint development of logistics processes.

The second reason why the initial grouping of factors is not sufficient, is that part of the selected papers use heterogeneous groups of items to measure SCM factors. Again, we refer to Carr and Pearson (1999) with items varying from loyalty and frequent face-to-face communication to direct computer links with suppliers.

Based on a close examination of all items used in the selected surveys, we propose to categorise these items as attitude, pattern or practice. SC practices are concrete activities or technologies that play an important role in the collaboration of a focal firm with his suppliers and/or customers. Examples are the use of Electronic Data Interchange (EDI), integrated production planning, packaging congruence and deliveries synchronisation (see for instanceDe Toni and Nassimbeni, 1999; Frohlich and Westbrook, 2001). Related to these practices are the SC patterns or interaction patterns between the focal firm and its suppliers and/or customers. Examples are regularly visits to the supplier's facility, frequent face-to-face communication, high corporate level communication on important issues with key suppliers and formal, periodic written evaluation of suppliers (see for instance Carr and Pearson, 1999; Tan et al., 1999; Stanley and Wisner, 2001). The last category of items includes items that measure attitude of buyers and/or suppliers towards each other or towards supply chain management in general. Examples used in the questionnaires are "we expect our relationship with key suppliers to last a long time", "we view our suppliers as an extension of our company", "problems that arise in the course of this relationship are treated as joint rather

than individual responsibilities" and "the responsibility for making sure that the relationship is works for both the other party and us is shared jointly" (see for instance Chen et al., 2004; Johnston et al., 2004).

Table 2.3.1 provides an overview of the SCM factors used in the survey and the type of items used to measure these factors. In a number of surveys, it is difficult to decide whether items are to be considered as attitude, pattern or practice. This is mainly because some of the authors use rather aggregated constructs, like supplier partnership defined as "bringing all of the participants in the product life cycle into the process early on so even suppliers and customers can provide input to each others' processes" (Droge et al., 2004). The results presented in the table confirm that a wide variety of items are used to measure supply chain management and/or integration. Moreover, detailed comparison of the items or constructs used shows that most authors do not build upon research of their predecessors. A more principle observation from the 16 papers examined is that there is too little consideration for the inter-relationships between attitudes, patterns and practices. We return to this aspect in the discussion part of this paper.

Performance measurement

All the included surveys examine the relationship between supply chain management and performance. Most surveys examine the relationship between SCM attitudes, patterns and/or practices and the performance of the focal firm, in many cases the buying firm. The performance of the suppliers of the focal firm is not measured in most articles.

Again, there are also large differences between the surveys selected. The surveys differ with respect to the items used to measure performance and the way performance is measured. Table 2.3.2 shows that the majority of the surveys examine the effect of SCM on financial or overall performance as well as on customer service. Chen et al. (2004), Droge et al. (2004) and Vickery et al. (2003) examine the direct relationship between SCM factors and financial performance and the indirect relationship with customer service as a mediating variable. Others only examine direct relationships and use factors that include financial as well as customer service items in their research. Table 2.3.2 also shows that there is a smaller group of surveys in which performance is restricted to customer service or financial performance.

With respect to the measurement of performance, all authors except Salvador et al. (2001) use subjective assessment of performance. The use of subjective assessment is some cases justified by referring to Narasimhan

and Das (2001) and Venkatraman and Ramanujam (1986). In a recent paper on subjective measures, Ketokivi and Schroeder (2004) conclude that perceptual measures are a viable alternative in large-sample studies as long as rigorous examinations of validity are performed. In the next section, this viewpoint is discussed in a broader context.

Eleven out of 16 assess the performance relative to the performance a number of years ago or relative to major competitors. For instance, in Chen et al. (2004) financial performance is operationalised by items indicating the extent of changes in (1) return on investment, (2) profits as a per cent of sales and (3) net income before taxes over the past three years. Vickery et al. (2003) measure customer service relative to major competitors and with respect to five items: product support, pre-sale customer service, responsiveness to customers, delivery speed and delivery dependability/reliability. Ramdas and Spekman (2000), Stanley and Wisner (2001) and Johnston et al. (2004) use perceptual measures

Table 2.3.2 Performance measures in SCM research

Performance measurement	**Customer service, responsiveness and/or time-based performance**	**Overall performance, market share and/or financial performance**	**Combination or path**
Subjective assessment	Ramdas and Spekman (2000), Stanley and Wisner (2001)	Johnston et al. (2004),	
Subjective assessment relative to performance × years ago		Carr and Pearson (1999)	Gimenez and Ventura (2005), Chen et al. (2004), Frohlich and Westbrook (2001), Shin et al. (2000)
Subjective assessment relative to major competitors	Stank et al. (2001)	Tan et al. (1999)	Droge et al. (2004), Scannell et al. (2000), De Toni and Nassimbeni (2000), Prahinski and Benton (2004), Vickery et al. (2003)
Objective assessment	Salvador et al. (2001)	Carr and Pearson (1999)	

for performance but not relative to the performance a few years ago nor relative to the major competitors. Stanley and Wisner, for instance, ask the focal firm to assess the *current* level of service and quality provided by the focal firm to its external customers with respect to items like fast delivery of products/services and flexibility to customer's changing needs.

Variety with respect to performance measurements appears to be as large as it is with respect to the measurement of supply chain management or integration. More fundamental is the observation made at the start of this section that most authors measure the performance of the buying firm, whereas the integration is measured in the relationship with its suppliers. If we assume that integration means investing in a buyer-supplier relationship, it would make sense to measure performance in terms of the aims of these efforts with respect to this particular relationship. Possible aims are to reduce reaction times and/or stocks but also to increase the visibility in the chain or to attain a more effective and efficient way of communication. Only a few of the selected papers measure the performance of the relationship or the performance of the supplier in the relationship. Johnston et al. (2004) measure the buyer's perception of the relationship's performance and the buyer's satisfaction with the relationship. Giménez and Ventura (2005) measure the manufacturer's performance in the relationship with their customer (retailer). Other exceptions with respect to this issue are Prahinski and Benton (2004) and Shin et al. (2000).

Relationship between SCM factors and performance

An important conclusion based on the previous two sections is that there is no consensus on how to capture the essence of SCM or SC integration and on how to measure the effect of SCM or SC integration on performance. In this section, we take this point of concern as a starting point for the discussion on the current status of SCM survey research. The main point is to investigate if and how the surveys help in understanding how SC performance can be improved and which integrative practices help.

We already stated that it is at least risky to examine the relationship between SCM factors and performance without measuring, investigating and understanding the interrelationships between different SCM factors. This is especially true for the relationship between SCM attitudes (like loyalty, trust and commitment), SC patterns and SC practices. The daily interactions within a relationship will affect the

attitudes towards each other and towards supply chain management and vice versa (compare IMP group, 1990). Because of these complex interactions, it seems dangerous to investigate the relationship between attitudes and performance without properly accounting for these interactions. More generally, it seems far fetching to establish relationships between the attitude of a buying firm towards their suppliers and the financial performance of the buying firm. For instance, the fact that a buying firm is loyal to its suppliers has no immediate relationship with the ROI of the buying firm. Therefore, it is also not surprising that Vickery et al. (2003) did not find a significant direct relationship between supply chain integration and firm performance. An additional complicating factor is that in many of the contributions, integration is only measured in relation to the relationship with the most cooperative partner (supplier or customer) or the relationship with key partners. If integration is measured in one or a small number of relationships of the focal firm, it is especially difficult to establish a relationship with the overall performance of the focal firm. To conclude this point, it is unclear what the theoretical model is and if the relationships found have value for managerial decision-making. Who believes that increasing the trust in your supplier will raise profits?

In line with the arguments provided in this section and the previous ones, it seems more logical, especially from a conceptual point of view, to start with the relationship between SC practices (or patterns) and the performance of the supplier or the buyer-supplier relationship (BSR) itself. Attitudinal aspects are then primarily relevant in understanding the level of integration (practices and patterns) within the particular relationships (see Figure 2.3.1). As mentioned before, the interaction between the parties will influence the attitude and vice versa.

If the aim of SCM research is to relate integration efforts in buyer-supplier relationships to the buyer's firm financial performance, we

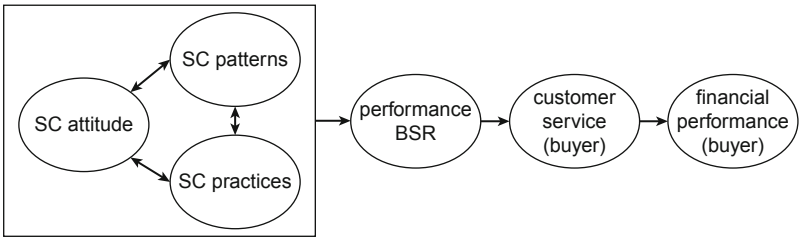

Figure 2.3.1 Research model

propose to investigate a path from the performance of the buyer-supplier relationship, via customer service, to the financial performance of the buying firm. A possible advantage of relating integration to the performance of the relationship is that is relatively easy to acquire reliable, less subjective, performance measures for the performance of the relationship especially compared to financial performance measures. From a methodological point of view, we advocate an approach in which research is not only based on data obtained from more than one respondent per firm, but also on data obtained from respondents of both companies in the buyer-supplier relationship (e.g., Johnston et al., 2004).

In many of the selected papers and in our discussion so far, there is an implicit assumption that higher levels of integration in the supply chain automatically lead to an improved performance. Van Donk and van der Vaart (2004, 2005) disagree with the assumption that more integration is always better. Based on both theoretical concerns and empirical evidence, they show that it is important to understand the influence of business conditions on the level of integration and the type of integrative activities employed. One of the main factors is the influence of demand characteristics or uncertainty on the type of practices employed: an issue also addressed by Fisher (1997), Mason-Jones and Towill (1998) and Childerhouse and Towill (2002). Other relevant business conditions are the decoupling point (MTO/MTS), time window for delivery, volume-variety characteristics, process type (batch size, set-ups and routings) and order winners. In line with Davis (1993), these factors are important indicators for the amount of uncertainty suppliers are facing in their production planning and delivery schedules. Van Donk and van der Vaart (2004) state that higher levels of integration can be expected in supply links if suppliers' business conditions are characterised by low volume, high product variety, small batches, make-to-order, a long time window for delivery and flexibility among the main order winners. These conditions correspond with a high level of uncertainty within the supply link. If business conditions are to a larger degree characterised by high volume, low product variety, large batches, make-to-stock, a short time window for delivery and costs as a major order winner, lower levels of integration are expected.

Among the survey papers selected, only the paper by Ramdas and Spekman (2000) explicitly includes business conditions or context. They find differences in supply chain practices in functional products supply chains as opposed to those in innovative products chains. This stream of research partly answers the remark by Frohlich and Westbrook (2001,

p. 185): "Our knowledge is relatively weak concerning which forms of integration manufacturers use to link up with suppliers and customers". The general conclusion is that in complex business conditions higher levels of integration are required and different SC practices are appropriate. This implies that there should be a fit between the SC practices and patterns and the business conditions (see also van Donk and van der Vaart, 2004, 2005).

Conclusions

The aim of this paper is to review a number of recently conducted surveys. In view of the fast developments in the field of SCM, it is not surprising that there is not yet a coherent view on the relationship between SC integration and performance. From our review, we derive a number of conclusions. The general conclusion is that the convergence in research is relatively small. Each author starts by developing a new model with new factors and measurement scales, and diversity is thus large.

In the papers, one can distinguish three different categories of variables and items: those measuring attitudes, those measuring patterns and those measuring practices. However, this is not made explicit in the research. We submit that each category should be conceptually distinguished and measured separately.

The measurement of performance is diverse as well. The main point addressed here is that performance of the SC relationship under study is hardly assessed, but that mostly the effect of SC initiatives for the performance of the focal firm is investigated.

The surveys reviewed have investigated relationships in different types of industries, but a systematic analysis of the effect of business conditions has been neglected. Here, an important area for future survey-based research can be distinguished.

A major limitation of the current review is that we have not yet included all survey-based papers and that we have limited our search to a restricted number of journals. Another restriction might be that the authors of some of the articles might share part of our criticism but have valid arguments for their particular choices. However, we strongly advocate taking into account the points brought forward in the previous sections and summarised above. Supply chain management research can and should try to better understand under what circumstances which integrative efforts pay off. If we better understand that type of relationship, we will be able to improve our teaching and help managers in improving their business.

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