Obstacles to supply chain integration of the performance management process in buyer-supplier dyads: The buyers' perspective

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ABSTRACT

Purpose: The purpose of this article is to explain to what degree supplier relationship obstacles and operational tool obstacles hinder supply chain integration of the performance management process.

Methodology/approach: This is a hypothetic-deductive study, where the results are based on a survey to 257 purchasing managers in nine manufacturing industries in Sweden.

Findings: Supplier relationship obstacles (lack of trust, different goals and priorities and lack of parallel communication structure) were found to significantly hinder performance management process integration the most, which is in accordance with previous studies. The operational tool obstacles (manual performance data management and non-standardized performance metrics) were seen on an overall level to hinder performance management process integration. However, the hypothesis that non-standardized performance metrics hinder performance management process integration was not verified, which does not accord with previous studies.

Research limitations/implications: Using single informants in data collection.

Practical implications: Contrary to previous studies, it has applied a broader, quantitative survey methodology, and hence provides deeper knowledge about the impact of obstacles on performance management process integration. It identifies critical obstacles which are important for industry to overcome.

Originality/value of paper: Most previous studies of supply chain performance management are either case-based or experience-based. Here, hypotheses are tested on empirical data and general results presented regarding lack of supplier relationships and operational tools as obstacles for supply chain integration of performance management.

Type of paper: Research paper

Keywords: Performance management, Logistics performance, Process integration, Obstacles, Supply chain integration

Introduction

Supply chain management is largely about up- and downstream process integration. Integration is here defined to mean that two companies jointly conduct and agree upon activities in the supply chain. This article has a focus on the performance management (PM) process, which can be described as consisting of five activities: selecting performance variables, defining metrics, setting targets, measuring and analysing (Forslund, 2007). Cooper *et al.* (1997) demonstrated the importance of identifying what processes to integrate with supply chain partners and what extent of integration and management should be applied for each process link. The issue of when and how far to integrate is relevant for all supply chain processes, as well as the PM process. Integration of the PM process has for example been recommended by Holmberg (2000a) and Bowersox *et al.* (1999). Customer-supplier integration and collaboration through the use of PM was stated by Cousins *et al*. (2008) to be an important avenue for research. Supply chain integration is considered one major factor in improving performance, although little consensus is found in literature on how to measure it (e.g. van der Vaart and van Donk, 2008). Forslund and Jonsson (2007b) and Cousins *et al*. (2008) showed positive relationships between PM and supply chain delivery performance. Despite this, the degree of PM process integration in customer-supplier dyads is low (e.g. Forslund and Jonsson, 2007a).

To integrate the PM process is not, however, only an issue of when and how far. There exist a number of obstacles to integration, and they can be of different types. Brewer and Speh (2001) emphasized, for example, the importance of overcoming lack of trust developed from new ways of working with PM and the fact that the goals of the partners may differ significantly because of different competitive situations, financial circumstances and environments,. Difficulties of developing a collaborative culture and appropriate performance metrics are also identified as major barriers for collaborative performance management (Holmberg, 2000a; Brewer and Speh; 2001, Busi and Bititci, 2006, Forslund and Jonsson, 2007a). Another PM integration obstacle emphasized in the literature is information systems incapable of gathering non-traditional data or generating appropriate PM reports (Bourne *et al.*, 2000; Lohman *et al.*, 2004; Busi and Bititci, 2006;

Forslund and Jonsson, 2007a, 2007b). Another obstacle found in previous studies (Holmberg, 2000a; Brewer and Speh, 2001; Forslund and Jonsson, 2007a) is non-standardized performance metrics. These obstacles to PM process integration can be structured into two types based on their character: obstacles related to the relationship between supply chain partners, and the more operational obstacles related to the "tools" that are applied. Not only inadequate supplier relationships, but also more operational tools, seem to hinder PM process integration.

The degree of PM process integration should not only depend on the existence of integration obstacles. Company internal conditions, such as who is responsible for the measurement process, and the tradition and characteristics of measuring and collaborating in the industry and supply chain may also impact the degree of PM integration. Another reason for lack of PM process integration may be that it has to mature over a long period of time in an evolutionary manner, i.e. similar to development of long-term relationships. The mentioned studies are mainly based on case studies or experience (Brewer and Speh, 2001; Holmberg, 2000a; Forslund and Jonsson, 2007a). It would therefore be valuable to conduct a broader, survey based study in order to verify their results. An important problem approached in this article is consequently: Which are the most important PM process integration obstacles and how do they actually hinder PM process integration?

The purpose of this article is to explain to what degree supplier relationship obstacles and operational tool obstacles hinder PM process integration. The article is organized as follows. A theory review of obstacles to PM process integration results in two overall assumptions and five associated hypotheses. The methodology section treats the survey and how empirical data were collected. A section on findings shows the results from a correlation analysis and a hierarchical regression analysis. The results are discussed and conclusions drawn.

Obstacles to PM process integration

This section is divided into supplier relationship obstacles and operational tool obstacles. Based on a theoretical review, two overall assumptions and five hypotheses are formulated.

Supplier relationship obstacles

A first overall assumption is derived from the discussion in the introductory section:

Assumption 1: Supplier relationship obstacles hinder PM process integration.

The supplier relationship obstacles need to be further specified in order to enable measurement. Such obstacles are here related to lack of trust in the relation, different goals and priorities, and lack of parallel communication structure between supply chain partners. These obstacles are discussed below.

Lack of trust. Maintaining an arm's-length relationship with suppliers and customers is a long-term habit. Consequently, new ways of working, e.g. with PM, may be met with scepticism and mistrust (Brewer and Speh, 2001). Zineldin and Jonsson (2000) argued that trust exists when one party has confidence in a collaborative exchange partner's reliability and integrity. This definition parallels that of Moorman *et al.* (1993) that "trust is defined as a willingness to rely on an exchange partner in whom one has confidence". The behaviour intention of willingness is also a critical facet of trust's conceptualization, because if one believes that a partner is trustworthy without being willing to rely on that partner, trust is limited (Moorman *et al.*, 1993). Anderson and Narus (1990) expressed a similar meaning when defining trust as "the believe that another company will perform actions that will result in positive outcomes for the firm as well as not take unexpected actions that will result in negative outcomes". Chan (2003) emphasizes the importance of reliable risk and information sharing in trustworthy relationships. Definitions of trust, thus, emphasize the importance of confidence in the other party and the belief that the trustworthy party is reliable, frank and honest and willing to share risks and information.

Every company as an entity of the supply chain has its own way of doing business. Why should companies trust their supply chain partners in sharing sensitive information, or why should they be willing to be monitored by others than their own share- and stakeholders? This natural mistrust needs to be overcome for a successful PM system throughout the supply chain, which is not common. Supply chain collaboration using collaborative performance metrics implies that every partner should trust its partners and at the same time be trusted by its partners (Simatupang *et al.*, 2004). Trust between organizations was operationalized by e.g. Moorman *et al.* (1993), Zineldin and Jonsson (2000) and Chan (2003). Several studies have shown that trust is an important driver for supply chain integration (e.g. Fynes *et al*. 2005; Myhr and Spekman, 2005; Sheu *et al*., 2006). Forslund and Jonsson (2007a) did a case study on dyadic integration of the PM process, and identified trust as positively affecting the degree of PM integration. Lack of trust should therefore be an obstacle to PM process integration, and we formulate the first hypothesis (H1a) in the following way:

H1a: Lack of trust is an obstacle that hinders PM process integration.

Different goals and priorities. The goals of the partners can differ significantly because of different competitive situations, financial circumstances and environments (Brewer and Speh, 2001). The supply chain's performance depends upon the joint performance of all members, while each firm's management is obligated to its own stake- and shareholders, missions and objectives which might be in direct conflict with each other. The importance of linking manufacturing, marketing and corporate strategies has been understood and emphasized for a long time (e.g. Skinner, 1969, Hill, 2000, Da Silveira, 2005). Once internal strategies are understood and linked, appropriate supply chain strategies can be designed and implemented. Quesada et al. (2008), for example, explained the relationship between internal order winners and supplier integration strategies, and Aitken et al. (2005) developed a model for linking market qualifiers and order winners to supply chain strategies. APICS (2007) emphasized the importance of aligning corporate and supply chain strategies as a key supply chain objective. In accordance with the above literature, we argue that if the goals and priorities of the individual business partners are not aligned with common goals and priorities of the inter-organizational business processes it is less likely that the PM process is integrated between the two companies. The second hypothesis (H1b) is formulated accordingly:

H1b: Different goals and priorities are obstacles that hinder PM process integration.

Lack of parallel communication structure. Lack of buyer-supplier communication is identified as a potential contributor to low or failed buyer-supplier cooperation (Heide and Miner, 1992; Krause and Ellram; 1997, Kalafatis, 2000). There are two basic types of communication structures: serial and parallel. In a serial communication structure, the buyer firm's purchasing department and the seller firm's sales department process most or all of the inter-organizational information. In parallel communication, the buyer's purchasing department and the seller's sales department facilitate and coordinate the transfer of quality information rather than process it by themselves. Communication of operational issues is taking place directly between the responsible functions, processes and individuals in the two organizations. Studies have shown several positive effects of parallel communication structures on cooperation and logistics performance (Carter and Miller, 1989; Krause and Ellram, 1997). A parallel communication structure should also be a facilitator for PM process integration, because it is a facilitator for common priorities and quality improvement (Carter and Miller, 1989). We thus formulate the third hypothesis (H1c) as follows:

H1c. Lack of parallel communication structure is an obstacle that hinders PM process integration.

Operational tool obstacles

Also for operational tool obstacles, an overall assumption can be based on the discussion in the introductory section:

Assumption 2: Operational tools are obstacles that hinder PM process integration.

The operational tool obstacles described and studied in this article are manual performance data management and non-standardized performance metrics.

Manual performance data management. Performance data management refers to the gathering and registering of PM data and the generating of PM reports. Managers may not be willing to share critical information that is required to make qualified decisions in the supply chain (Pohlen and Coleman, 2005). However, House and Stank (2001) report that periodic lapses in communication may encourage participants to dissociate themselves from the responsibility for partnership relationship objectives and follow their own agendas instead. Feedback and mutual participation, in for example target setting and measurement, are identified as critical factors to achieving supply chain coordination and integration (e.g. Anderson and Narus, 1990, Forslund and Jonsson, 2007b). Studies show that information system capabilities provide important platforms for such supply chain coordination and integration (Croom, 2001, Sheu *et al.*, 2006; da Silveira and Cagliano, 2006; Ambrose *et al.*, 2008). Ambrose *et al.* (2008) pointed out the increasing needs for communication as the customer-supplier relation develops. Most corporate information systems, however, are incapable of gathering non-traditional information relating to supply chain performance (Brewer and Speh, 2001). Bourne *et al.* (2000), Lohman *et al.* (2004) and Hervani *et al.* (2005) also reported computer system issues as a problem in supply chain PM. Concretely, this means that companies might have to update their IT systems for taking part in the performance measurement system. Investments can be a logical consequence. The low level of PM integration in the study by Forslund and Jonsson (2007a) was found to be related to poor intra-organizational informational integration, since most companies regard their ERP systems as dysfunctional and have to move data to Excel in order to produce usable performance reports, something that has also been mentioned by Bourne *et al.* (2000), Lohman *et al.* (2004) and Busi and Bititci (2006). When it is unconvenient to generate a PM report, it seems to be done with low frequency, hence reducing its value. The following hypothesis regarding PM process integration obstacles can therefore be generated:

H2a: Manual performance data management is an obstacle that hinders PM process integration.

Non-standardized performance metrics. A supply chain PM system will only work when all partners have agreed on a measurement approach (Brewer and Speh, 2001). Literature show that shared values and extensive communication are important for supply chain coordination and integration (Zineldin and Jonsson, 2000). In the absence of such situations, formal, standardized procedures, e.g. in a contract, could be applied to eliminate ambiguity (Daugherty *et al.*, 1992). There is, however, no commonly accepted language or conceptual framework concerning PM (Schmitz and Platts, 2004). Standardized metrics could, for example, be found in the SCOR model (Lockamy and McCormack, 2004) or in Odette's materials management operations guidelines/logistics evaluation (MMOG/LE) used in the automotive industry (Odette, 2007), but their use is not widespread (Forslund and Jonsson, 2007b). With an increasing number of participants involved in the PM process, achieving a consensus will become harder with every additional member. In order to link companies together, they need to agree on the same metrics and measurement systems, something that very few companies are able to do (Holmberg, 2000a; Wu and Song, 2005). Forslund and Jonsson (2007a) found that a general obstacle for PM integration in all dyads was the lack of standardized metrics or common metric definitions. Difficulties of developing appropriate performance metrics are also identified as major barriers for collaborative performance management (Holmberg, 2000a; Brewer and Speh, 2001; Busi and Bititci, 2006). Consequently the following hypothesis regarding PM process integration can be generated:

H2b: Non-standardized performance metrics are an obstacle that hinders PM process integration.

Control variable obstacles

In addition to the supplier relationship and operational tool obstacles, three variables which are expected to affect the supply chain integration of the performance management process are identified as control variables. The first control variable is company size. Company size has been identified as a cause for the buyer firm to engage in socialization with suppliers (Cousins *et al.*, 2008). Larger companies can therefore be expected to have integrated the performance management process with its suppliers to greater extent than smaller firms. The second control variable is supply chain position. We expect several OEM companies to be characterized of frequent supply of multiple items, and time and quantity synchronization of requirements and supply to be critical. On-time delivery is consequently expected to be a prioritized measure for these companies. The last control variable is the perceived importance of integrating the PM process with its suppliers. Cooper *et al.* (1997) emphasized the importance of identifying what processes to integrate with supply chain partners and how to integrate them. In companies identifying the performance management process as important to integrate, we thus expect the process to be more integrated compared to companies where the process is not considered important to integrate.

Methodology

This section contains information on the survey instrument, on how empirical data were collected, and on the study's reliability and validity.

Survey instrument

A survey instrument was developed, containing 22 questions. To ensure both content and construct validity, as recommended by Flynn *et al.* (1990), scales were drawn directly from existing sources or based on extensive literature reviews. The questionnaire was first pre-tested on senior researchers in logistics, operations and supply chain management. It was then discussed with five purchasing and process managers, familiar with survey studies, in some of the different industries addressed. This lead to some adjustments in wording and in added response alternatives. It was then transferred into a web-based questionnaire. The operationalization and the scales used for the respective variables are described below. The survey instrument is included in Appendix A.

PM process integration. The dependent variable of PM process integration was measured as a four-dimensional index, focusing on the PM process activities: defining metrics, setting targets, measuring and analyzing, derived from Forslund and Jonsson (2007a). A seven-point interval scale (from one to seven) was used.

Lack of trust. An index, made up of four individual items, for the variable of trust was derived from Moorman *et al.* (1993), Chan (2003) and Zineldin and Jonsson (2000). A seven-point interval scale was used. The survey measured the construct of trust, but in the analysis the construct "lack of trust" is used. Lack of trust was defined as "8 minus Trust".

Different goals and priorities. The third supplier relationship variable, common goals and priorities regarding logistics performance, was measured as a single-item variable on a seven-point interval scale, derived from Brewer and Speh (2001). The survey measured the construct "common goals and priorities" but in the analysis the construct "different goals and priorities" is used. The variable of different goals and priorities was defined and calculated as "8 minus Common goals and priorities".

Lack of parallel communication structure. A two-dimensional index measuring the number of organizational units and staff communicating in parallel between the organizations was derived, based on Krause and Ellram (1997) and Carter and Miller (1989). A seven-point interval scale was used. The survey measured "parallel communication structure" but in the analysis the construct "lack of parallel communication structure" is used. Lack of parallel communication structure was defined and calculated as "8 minus Parallel communication structure".

Manual performance data management. An index based on two questions on ordinal scales was derived to measure manual performance data management. The first measured the extent of manual involvement necessary for gathering and registering on-time delivery measurement data (delivery date, number of received orders/order lines, etc.), and the second measured the extent of manual activities necessary for generating on-time delivery measurement reports.

Non-standardized performance metrics. The use of standardized performance metrics was measured as a nominal scaled dummy variable.

Control variables. Three control variables were applied in the survey instrument. Company size and supply chain position were measured as number of employees and as 2^{nd} tier, 1^{st} tier or OEMs, on three-point ordinal scales. The customers' perceived importance of integrating the PM process was measured with a seven-point interval scaled, four-dimensional index. The same dimensions as for PM process integration were used.

Empirical data

Data were collected during Spring 2007. Customer companies in environments where on-time delivery is expected to be important were sought for. Most manufacturing companies, no matter firm size and industry, normally have on-time delivery as an important supply performance (Keebler *et al.*, 1999, Forslund and Jonsson, 2007a). However, in environments characterized by frequent orders, converging material flows and a large share of make-to-order strategies we expect on-time delivery to be especially important. These characteristics can be identified in several industries. We have limited the population to manufacturing companies related to ten industry codes (see Table I). In these industries we expect convergent material flows being dominant and thereby also on-time delivery being an important measure. Purchasing managers were addressed, in order to capture information about the relation with the most important supplier (measured as volume by value). Addressing individual customer-supplier relationships in order to reach specific results, as is done here, was recommended by for example van der Vaart and van Donk (2008). The selected industries are shown in Table I, together with information on sample size and response rate. Those companies where the address was wrong (returned) or where classification was wrong (regarding industry, number of employees or where no production existed) were categorized as not relevant.

Table I. Sample profile and response rate per industry

Industry code	**Sample**	**Not relevant**	**Adjusted sample**	**Responses received**	**Response rate**	**Response % per industry**
24. Chemical industry	98	8	90	38	42.22	14.78
25. Rubber and plastic industry	57	1	56	23	41.07	8.95
28. Metal product industry	256	26	230	96	41.74	37.35
29. Machine industry	143	16	127	50	39.37	19.45
30. Office machinery	3	1	2	2	100	0.78
31. Electrical industry	27	5	22	13	59.09	5.06
32. Telecommunications products industry	18	2	16	7	43.75	2.73
34. Motor vehicle and trailer industry	39	3	36	9	25	3.50
35. Other transport equipment industry	17	4	13	5	38.46	1.95
36. Furniture/other manufacturing industry	47	6	41	14	34.15	5.45
Total	705	72	633	257	40.60	100

Purchasing managers in companies with more than 100 employees were selected. The aim was to address large companies, in order to discover an awareness of performance management issues and to find respondents understanding the terminology used in the questionnaire. Chenhall (2003) stated that larger companies can be related to larger operations, division of labour and specialization of functions and roles. Some companies had more than one site, which explains why also companies with less than 100 employees were included. In Table II, the distribution of company sizes in the sample is shown together with response rate.

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Table II. Sample profile and response rate per company size – number of employees

No of employees	Sample	Not relevant	Adjusted sample	Responses received	Response rate	% per size
<100	72	10	62	21	33.87	8.17
100-199	356	34	322	144	44.72	56.03
200-499	196	20	176	66	37.5	25.68
500-999	58	3	55	22	40	8.56
>1000	23	5	18	4	22.22	1.56
Total	705	72	633	257	40.60	100

E-mail addresses were obtained from a database (PAR) from the Swedish Postal Services. Each respondent received an e-mail with a personal link to a web-based questionnaire. A reminding e-mail was sent to those who had not replied after a week. After that, non-respondents were phoned at least twice to encourage completing the survey. Altogether a response rate of 40.6%, of the sample size of 705 respondents, was reached. The high response rate of this survey makes the risk of non-respondent bias small. Respondents and non-respondents were compared regarding industry and company size/number of employees. Chi-square statistics between respondents and non-respondents regarding six industry types (industries 30, 31 and 32 were grouped into one type and 34 and 35 into another) were conducted. No significant difference between respondents and non-respondents was found. Chi-square tests between respondents and non-respondents regarding company size were also conducted. No significant difference between respondents and non-respondents regarding company size was found.

Table III. Mean, standard deviation and reliability coefficients of scales

Scale	Mean (Std.Dev.)	Cronbach's Alpha
Dependent variable		
PM process integration	4.19 (1.78)	0.87
Suppler relationship obstacles		
Lack of trust	3.01 (1.34)	0.90
Different goals and priorities	2.89 (1.52)	N/A
Lack of parallel communication structure	4.39 (1.65)	N/A
Operational tool obstacles		
Manual performance data management	2.01 (0.54)*	N/A
Non-standardized performance metrics	N/A	N/A
Control variables		
Size	N/A	N/A
Supply chain position	N/A	N/A
PM integration importance	5.77 (1.38)	0.85

*Ordinal scale handled as interval scale

Table III shows descriptive statistics for interval-scaled measures. Non-standardized performance metrics were measured as a dummy variable. Of the 256 answers, 212 (84%) indicated that no standardized metric was used. Of the respondents, 144 (52%) represented small companies (100-199 employees), while 77 (28%) and 55 (20%), respectively, represented medium-size (200-499 employees) and large-size (>500 employees) firms. Also among the respondents, 159 (59%) were OEM companies, 90 (34%) were first-tier suppliers and 19 (7%) were second-tier suppliers.

Reliability and validity

Reliability is increased by using a standardized, structured measurement instrument and providing instructions. A test of non-respondent bias is one part of a reliability analysis. As the study's reliability was acceptable, a prerequisite for validity was obtained. All items in the multi-item scales loaded on single factors with factor loadings higher than 0.6 when conducting principal component factor analyses. The inter-item reliability for multiple scales was also acceptable, with alphas between 0.85 and 0.90. Table III shows Cronbach's alpha values for scales measured on interval scales.

Findings

The section analyses the overall assumptions: (1) that supplier relationship obstacles hinder PM process integration, and (2) that operational tool obstacles hinder PM process integration. Table IV shows the correlations between each of the supplier relationship obstacles, operational tool obstacles, control and PM process integration variables. There are only three significant relationships between the independent variables. These are between the two relationship variables of lack of trust and different goals/priorities, between the two operational tool variables of manual performance data management and non-standardized metrics, and between size and lack of parallel communication structure. The correlation between lack of trust and different goals/priorities is larger than 0.6, and will consequently result in multi-collinearity effects in the regression models presented later in the article. Lack of trust, PM integration importance, different goals and priorities, lack of parallel communication structure, and manual performance data management are the independent variables with most significant correlation with PM process integration.

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Table IV. Pearson correlations[1] between variables

Variables									**Variables**
Size	Supply chain position	PM integration importance	Lack of trust	Different goals/priorities	Lack of parallel communication structure	Manual performance data management	Non-standardized metrics	PM process integration	
-	0.001	0.104	0.030	0.026	-0.268**	-0.086	-0.016	-0.046	Size
	-	-0.030	-0.003	0.043	-0.107	0.059	0.057	-0.036	Supply chain position
		-	0.013	0.006	-0.081	0.057	0.038	0.248**	PM integration importance
			-	0.607**	-0.012	0.129*	0.030	-0.393**	Lack of trust
				-	0.053	0.157*	0.051	-0.397**	Different goals/priorities
					-	0.089	0.134*	-0.169**	Lack of parallel communication structure
						-	0.179**	-0.139*	Manual performance data management
							-	-0.091	Non-standardized performance metrics
								-	PM process integration

* p <0.05; ** p<0.01, [1]The table shows Pearson correlations coefficients and significances. The same correlations are significant in Spearman rang correlation except for supply chain position and lack of parallel communication structure which is significant in Spearman correlation analysis and PM process integration and manual performance data management which is not significant in Spearman correlation analysis. The conformity of the test results indicates that the Pearson correlations should be reliable.

The procedure which is used to test the effect of supplier relationship and operational tool obstacles on PM process integration is hierarchical regression analysis. This procedure is considered appropriate because it facilitates an analysis of effects of variables and groups of variables in a controlled and incremental manner. The analysis is conducted in the following steps:

1. The three control variables are included.
2. The three supplier relationship variables are included.
3. The two operational tool variables are included.

Table V shows the results of the hierarchical regression analysis with PM process integration as dependent variable. All regression models are significant, with associated

F-tests significant at $p<0.01$. The regression model of the first step, which includes the three control variables, explains 5.8% of the variance in the PM process integration variable. The PM integration importance variable is the only significant variable of the three control variables. The inclusion of lack of trust, different goals and priorities and lack of parallel communication structure in the second step results in a model that explains a significantly larger amount of variance (R^2 = 0.268). The beta values of the relationship variables are significant and relatively high (0.26; 0.24; 0.13) and the incremental R^2 is as large as 0.22. Because of the high bi-variate correlation between lack of trust and different goals and priorities, it is somewhat hard to interpret the single beta figures of these two variables. Including manual performance data management and non-standardized metrics in the third model improves R^2 to 0.277 and results in a significant model. The beta for manual performance data management is significant, but not the beta for non-standardized metrics. In order to isolate the impact of the operational tool obstacle variables on PM process integration from the relationship variables impact, a regression model with the three control variables and the two operational tool obstacles was developed. R^2 for this model was 0.080 with a beta for manual performance data management of -0.157 as the only operational tool variable significant on the $p<0.05$ level.

Table V. Hierarchical regression analysis for PM process integration

Step	Variables	b	R^2	ΔR^2	F
1			0.058		5.33**
	Size	-0.05			
	Supply chain position	0.008			
	PM integration importance	0.251**			
2			0.268	0.219*	14.17**
	Size	-0.071			
	Supply chain position	-0.002			
	PM integration importance	0.250**			
	Lack of trust	-0.257**			
	Different goals and priorities	-0.236**			
	Lack of parallel communication structure	-0.132*			
3			0.277	0.016	11.80**
	Size	-0.092			
	Supply chain position	-0.017			
	PM integration importance	0.255**			
	Lack of trust	-0.259**			
	Different goals and priorities	-0.219**			
	Lack of parallel communication structure	-0.122*			
	Manual performance data management	-0.117*			
	Non-standardized performance metrics	-0.060			

Note: **$p<0.01$, * $p<0.05$

The regression model shown in Table V has several implications. First, it is shown that the control variable of PM integration importance has significant impact on PM process integration, but that size and supply chain position do not. Second, all supplier relationship variables have significant impact on PM process integration, especially the correlated variables of lack of trust and different goals and priorities – which are the single variables that explain the largest amount of variance in PM process integration. Third, manual performance data management, but not non-standardized metrics, further improves the regression model. The results therefore support both assumption 1 with its hypotheses 1a, 1b and 1c and assumption 2 with its associated hypothesis 2a. Hypothesis 2b was not supported.

Discussion

The hierarchical regression analysis shows that the control variable of PM integration importance has a significant impact on PM process integration. If PM process integration is not perceived as important by purchasing managers, this will consequently hinder PM process integration. The two other control variables, company size and supply chain position, were not identified as significant obstacles which give an indication that PM process integration is not related to company type.

All supplier relationship obstacles (Hypotheses 1a-1c) were found to hinder PM process integration. More precisely, lack of trust was found to be the most significant obstacle. This is in accordance with previous studies, such as Brewer and Speh (2001), Chan (2003), Simatupang *et al*. (2004) and Forslund and Jonsson (2007a). None of these studies were conducted with survey-based methodologies. Consequently, this study has contributed to deeper knowledge, showing through statistical hypothesis testing that lack of trust was the single variable that hindered PM process integration most significantly. This has a large practical implication, actualizing trust issues on the agenda for purchasing managers. Trust is often emphasised as the most important facilitator for supply chain integration. (e.g. Fynes *et al*.; 2005, Myhr and Spekman, 2005; Sheu *et al*., 2006). This study, thus, empirically validates these findings. The second most significant supplier relationship obstacle, different goals and priorities, is strongly correlated with lack of trust and also with lack of PM process integration. This finding emphasise the importance of aligning business and supply chain strategies. An obvious starting point for setting up a common PM process should consequently be to align the corporate goals and priorities with common goals and priorities of the inter-organizational business processes to be controlled and measured, as emphasized by, for example, APICS (2007).

The third supplier relationship obstacle, lack of parallel communication structure between the two business partners, was also found to significantly hinder PM process integration, although not to the same significant extent as lack of trust and different goals and priorities. More extensive communication between the business partners obviously has a direct impact on PM integration, but also indirectly since it is a facilitator for common priorities and quality development of the inter-organizational business process (Carter and Miller, 1989).

The operational tool obstacles were also found to hinder PM process integration. Manual performance data management – more precisely, manual performance data gathering, registering and report generation – has a significantly negative impact on PM process integration. This supports the results of Brewer and Speh (2001), Bourne *et al*. (2000), Lohman *et al.* (2004), Hervani *et al.* (2005) and Forslund and Jonsson (2007a). Again, previous research has been case-based (e.g. Lohman *et al.*, 2004; Forslund and Jonsson, 2007a) or based on theory and experience (e.g. Hervani *et al.*, 2005). No identified study has had a broader survey based approach. This study has highlighted this relationship through a hypotheses testing survey study. It is interesting to conclude that this obstacle still has not been "resolved", when companies are expected to be more and more computerized. The following question is thus raised: Is the automatic management of performance data not a prioritized issue in the companies?

Non-standardized performance metrics have been found to hinder PM process integration in many studies (Holmberg, 2000a; Brewer and Speh, 2001; Wu and Song, 2005; Busi and Bititci, 2006; Forslund and Jonsson, 2007a). In this study the impact of non-standardized performance metrics is not significant. Why is that? A main reason may be that, even if standard metrics exist in for example the SCOR model (Lockamy and McGormack, 2004) and in Odette (Odette, 2007), their use is not widespread (Forslund and Jonsson, 2007b). Another possible explanation is that the relation with the most important supplier is studied, and the partners may already have agreed on how performance metrics should be interpreted – there is some kind of "standardized performance metrics" in the relation. This may explain why the impact of this variable was not significant.

The study shows that the supplier relationship variables hinder PM process integration more than the operational tool variables and thus are the most important variables to focus on in order to create a situation suitable for PM process integration. However, the findings indicate that it is not enough to have supplier relationships based on trust, common goals and priorities, and with a parallel communication structure. In order to integrate the PM process in the supply chain, operational tools – mainly performance data management – must also be handled. This is no "either-or" situation; rather the management of the two types of obstacles supports each other and could be done in parallel.

Conclusions

The purpose of this article was to explain to what degree supplier relationship obstacles and operational tool obstacles hinder PM process integration. Four of five hypotheses were verified, and the regression model with the tested obstacle variables had a relatively high R^2 value. Supplier relationship obstacles (lack of trust, different goals and priorities, and lack of parallel communication structure) were found to significantly hinder PM process integration the most, and trust was the single most significant obstacle. The central roles of supplier relationship variables for general supply chain integration have been documented previously. The results from this study serve as a further empirical evidence of this effect. Furthermore, it proves that these variables, and especially trust, are important obstacles also for PM process integration. Few previous studies have studied the relationship between operational tools and supply chain integration. The study concludes that operational tool obstacles (manual performance data management and non-standardized performance metrics) also hinder PM process integration. However, the levels of significance are lower for the operational tool variables compared to the supplier relationship variables. The hypothesis that non-standardized performance metrics hinder PM process integration was not verified. Very few standardized metrics exist and consequently the use of such metrics is scarce. The low existence of standardized metrics may explain why this variable was not identified as a significantly important PM process integration obstacle. But this has to be further analysed in future research. The conclusions contribute with empirical evidence supporting several previously suggested, but not empirically tested, PM process integration obstacles. For example, the obstacle framework of Brewer and Speh (2001) could be empirically validated on three obstacles; lack of trust, different goals and priorities and manual performance data management.

The complexity in the relationship between the obstacles gives some managerial implications. The supplier relationship variables, and especially trust, were the most significant obstacles in the study but it would be a stretch to argue for a choice between overcoming supplier relationship or operational tool variables or prioritising between different supplier relationship variables. Instead, there are several obstacles which need to be approached and overcome in parallel in order to conduct PM process integration. This study supports this view in that almost all tested variables were significant determinants of PM process integration in the regression model. The perceived PM integration importance, trust and aligned goals and priorities were the most significant obstacle variables and could be expected to be necessary to approach and overcome in order to establish integrated PM. This study thus creates awareness that some obstacle variables may be necessary to overcome but both the supplier relationship and the practical operational tools are important to handle if the PM process would be integrated between customer and supplier. The purchasing manager hence needs to have both types of competencies and resources in order to facilitate PM process integration with important suppliers.

Some limitations can be identified in the study. It is delimited to ten Swedish industries and do not include companies with fewer than 100 employees. The focus is somewhat biased, since it is on a customer company's relationship with its most important supplier. More than one part's perspective should be taken to fully understand PM process integration. Here, only the customer company's perspective is taken. There are also delimitations related to the survey instrument. Only few related previous survey studies were found and little consensus was found in literature on how to measure supply chain integration (van der Vaart and van Donk, 2008). Therefore, new scales were developed for several variables and some of them are measured as single items. The fact that this study focused on integration obstacles could be seen as a limitation. The level of integration may also be explained by integration drivers which are not studied here.

This study was deductive and tested hypotheses derived from existing literature and theory. It still identified several streams of further research. One is the focus on standardized metrics. There exist some standardized logistics performance metrics, for example in the SCOR and Odette models, but they are not widely adopted or used.

Further research focusing on how to define standardized metrics and what is needed for increasing their use would consequently be valuable.

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Appendix A: Survey instrument

PM process integration. To what extent do you agree with the following? Seven point scale ranging from 1 (completely disagree) to 7 (completely agree):

a) We define the on-time delivery metric together with the supplier.
b) We set on-time delivery targets together with the supplier.
c) We measure the on-time delivery together with the supplier.
d) We analyze the on-time delivery outcome together with the supplier.

Trust: To what extent do you agree with the following? Seven point scale ranging from 1 (completely disagree) to 7 (completely agree).

a) Our interests are always considered when the supplier makes important decisions.
b) Promises made by this supplier are reliable.
c) The supplier is always frank in dealing with us.
d) If problems, such as shipment delays arise, the supplier's representative is honest about the problem.

Common goals and priorities: To what extent do you agree with the following? Seven point scale ranging from 1 (completely disagree) to 7 (completely agree).

a) We and the supplier have the same goals and priorities when it comes to logistics performance.

Parallel communication structure. To what extent do you agree with the following? Seven point scale ranging from 1 (single function/person) to 7 (most functions/persons).

a) How many of your internal functions (organizational units) have contact with the supplying company?
b) How many of your staff has contact with the supplying company?

Manual performance data management. Key for calculating index: a=1, b=2, c=3; Index= (answer 1 + answer 2/2).

1. To what extent is manual involvement necessary for gathering and registering on-time delivery measurement data (delivery date, number of receiver orders/order lines, etc)?

a) No manual activities – the data is automatically registered (e.g. with EDI) and is then available in our ERP system
b) Some manual activities – the data is registered manually and is then available in our ERP system
c) Much manual activities – the data is registered manually and is stored in a separate system to ERP (e.g. Access, Excel)

2. To what extent are manual activities necessary for generating on-time delivery measurement reports?

a) No manual activities – reports are generated automatically in the ERP system
b) Some manual activities – reports are generated in Excel etc and are based on data up-loaded from the ERP system, Access, etc.

c) Much manual activities – reports are generated in Excel etc and are based on data registered manually in the same system.

Non-standardized performance metrics. Dummy variable key: a, b or c = 1, d = 2.
Do you use some kind of standard metrics for on-time delivery?

a) Yes, according to SCOR
b) Yes, according to Odette (MMOG/LE)
c) Yes, other
d) No

Size. What is the total number of employees in your company's factory or site?

a) 100-199
b) 200-499
c) > 500

Supply chain position. For the supply chain where you and your supplier belong – what is your position?

a) 2nd tier supplier (supplier to supplier)
b) 1st tier supplier (supplier to OEM)
c) OEM

PM integration importance. To what extent do you agree with the following? Seven point scale ranging from 1 (completely disagree) to 7 (completely agree).

a) We should define the on-time delivery metric together with the supplier.
b) We should set on-time delivery targets together with the supplier.
c) We should measure the on-time delivery together with the supplier.
d) We should analyze the on-time delivery outcome together with the supplier.