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Supply chain integration and firm performance: an empirical study of Swedish manufacturing firms

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Abstract

Purpose – This article aims to explore the impact of supply chain integration on the financial performance of Swedish manufacturing firms.

Design/methodology/approach – The literature review provided the foundation for the development of the survey instrument and hypotheses for the study. In addition, the survey instrument was tested by the experts in the field and modified before it was sent to the managers in the survey group.

Findings – The findings show that supply chain integration at any level is beneficial to the financial well being of the firm. Companies with total supply chain integration reported the highest level of financial performance.

Research limitations/implications – Data were collected from Swedish manufacturing firms without regard to the size of the firm. The results show that supply chain integration is beneficial at any level.

Practical implications – The findings will assist managers with decisions regarding supply chain integration and its role as a critical factor in improving the financial performance of manufacturing companies.

Originality/value – Limited empirical studies have been conducted in this area, especially in Sweden. This study provides insight for manufacturing managers with regard to the importance of supply chain management and the competitive nature of business in the global market.

Keywords Competitiveness, Strategy, Supply chain, Integration, Performance

Paper type Research paper

Introduction

Value creation requires corporations to perform a set of activities to produce products or services that are perceived by customers to satisfy their needs. Increasing the value of these activities will increase the competitive position of the firm. Over the last two decades, companies have focused on developing a supply chain management strategy that streamlines activities involved in their internal and external processes to be more responsive to customer needs, reduce operational costs and to increase the financial performance of the firm. Christopher (2005) underscores that supply chain is a network of organizations from upstream (supplier end of the supply chain) through downstream (customer end of the supply chain) with integrated processes that produce value in the form of products and services for the consumer. According to Porter (1998), linkage

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between suppliers' value chains and a firm's value chain provides the firm with opportunities to improve its competitive position. An effective supply chain management can create short-term economic benefits as well as a long-term competitive advantage (Folinas *et al.*, 2004).

To improve the firm's performance through supply chain management, organizations must plan to integrate cross-functional activities within the firm and effectively link them externally with the processes of their business partners, suppliers and customers in the supply chain (Bechtel and Jayaram, 1997; Lambert *et al.*, 1998; Narasimhan, 1997). The supply chain integration strategy creates value for a firm's customers and draws suppliers and customers into the value creation process (Tan and Kannan, 1998; Vickery *et al.*, 2003).

An effective supply chain network requires organizations to form a partnership with the members of their supply chain network and employ advanced technology to link with their business partners and customers. The earliest form of electronic integration occurred in the 1970s with the development of electronic data interchange (EDI), which facilitated information exchange between buyers and suppliers. However, recent advances in electronic business and networks as well as communication technologies have made it possible for companies to fully integrate the complexities of supply chain management operations into a system that provides real-time supply and demand information along with materials flow visibility throughout the supply chain network.

The use of technology in creating an electronic supply chain network allows corporations to align the activities of the supply chain members with the demands of the markets and the customers they serve. Improving the efficiency and performance of the supply chain activities can increase profitability and create a competitive advantage for corporations.

An overview of related studies

Fisher (1997) suggests that supply chain, in general, performs two principal functions: a physical function which primarily deals with inventory management and logistics, and a market mediation function which matches supply with demand. The emphasis of inventory and logistics management is on relationships between suppliers and buyers and is the foundation for EDI allowing computer-to-computer information exchange and trading between members. Matching supply with demand requires firms to understand their customers' needs and to develop processes to fulfill customer orders. In this context, Akkermans *et al.* (2003) considers supply chain as an integrated network with three major parts: operational level, members and pillars. The operational level consists of financial flows, information flows and material flows. Financial flows deal with such activities as payment schedules, credit terms and title ownership arrangements. Order tracking, order transmission and coordination of material flows are part of information flows. Material flows represent physical product flows from suppliers to customers, as well as the reverse flows for product returns, servicing and recycling. Network members are suppliers, manufacturers, distributors, retailers and customers. In this system, there should be three pillars to support the network:

(1) processes which embed the firm capabilities in knowledge management, logistics and new product development;

(2) organizational structures which include management approaches, performance measurement and reward schemes; and

(3) enabling technologies to automate business processes and to facilitate the flow of information among members of the network.

Frohlich and Westbrook (2001) conclude that the most powerful and successful companies are those that link their customers and suppliers together into integrated networks. Four strategies for supply chain integration were introduced by Frohlich and Westbrook (2002). The first strategy deals with the standardization and automation of internal business processes across various functional areas of the firm. At this level, there is minimum or no integration with customers or suppliers. After the implementation of the first integration strategy, the firm can choose to implement the second strategy which is integration with suppliers or the third strategy which prescribes integration with customers. The second strategy enables corporations to create strategic linkages with their suppliers and to exchange information. The third strategy allows the company to develop a backward coordination of information and the flow of data from customers to suppliers. Finally, the fourth strategy is about the integration of supply and demand in both directions or total integration. In recent years, few empirical studies have been conducted to investigate the relationship between supply chain integration and the performance of the firm. Table I exhibits a summary of these studies.

Research objectives and design

The main objective of this study is to investigate the relationship between supply chain integration and the financial performance of manufacturing firms in Sweden. Based on the literature review presented in the previous section, two sets of hypotheses were developed. The first set is formulated to explore whether there is a positive relationship between the degree of integration and the financial performance of the firm:

H1a. Total supply chain integration (supplier-firm-customer) is positively related to financial performance.

H1b. Supply chain integration with the supplier is positively related to financial performance.

H1c. Supply chain integration with the customer is positively related to financial performance.

H1d. Supply chain integration within the firm is positively related to financial performance.

The second set examines if more integration provides better financial performance:

H2a. Total supply chain integration (supplier-firm-customer) will display the highest levels of financial performance.

H2b. Supply chain integration with the supplier will display medium levels of financial performance.

H2c. Supply chain integration with the customer will display medium levels of financial performance.

Table I.
Compendium list of empirical studies on integrated supply chain

Research study	Research method	Sample size	Location	Constructs	Analytical technique	Title	Findings
Frohlich and Westbrook (2002)	Survey	187 Manufacturers 298 Services	UK	New markets Anticipated performance External pressure Type of web-based Demand and supply integration Operational performance	ANOVA EFA Cluster Analysis Regression analysis	Drivers and performance of web integration	Demand chain management (DCM) led to the highest performance in manufacturing, but few signs of DCM in services The study also investigated DCM adoption drivers and found that rational efficiency and bandwagon effects drove change
Frohlich (2002)	Survey	486 Manufacturers	UK	Supplier barriers Internal barriers Customer barriers Supplier and customer e-integration E-business and operational performance	CFA SEM	e-Integration in the supply chain Barriers and performance	He found (1) a positive link between e-integration and performance, and (2) that internal barriers impeded e-integration more than either upstream supplier barriers or downstream customer barriers
Kim (2006b)	Survey	99 137 Manufacturers	Korea Japan	SC operation capability Competitive capability Firm performance	CFA Regression analysis	The effect of supply chain integration on the alignment between corporate competitive capability and supply chain operational capability	In firms with a high level of internal integration or external integration, such integration substitutes for the role of the interaction effect between corporate competitive capability and SC operational capability on performance improvement
Kim (2006a)	Survey	99 137 Manufacturers	Korea Japan	Level of SC integration Level of SCM practice Competitive capability Firm performance	CFA SEM	Effects of supply chain management practices, integration and competition capability on performance	This paper finds that, in small firms, efficient SC integration may play a more critical role for sustainable performance improvement, while, in large firms, the close interrelationship between the level of SCM practices and competition capability may have more significant effect on performance improvement

(*continued*)

Table I.

Research study	Research method	Sample size	Location	Constructs	Analytical technique	Title	Findings
Ranganathan*et al.* (2004)	Survey	249 Manufacturers Services	North America	Supplier interdependence Competitive intensity IT activity intensity Managerial IT knowledge Centralization of IT unit structure Formalization of IT unit structure Assimilation Diffusion Web-technology impact	SEM-PLS (partial least square) EFA	Assimilation and diffusion of web technologies in supply-chain management: an examination of key drivers and performance impacts	The findings suggest that internal assimilation and external diffusion of web technologies both significantly affect the benefits realized by SCM
Frohlich and Westbrook (2001)	Survey	322 Manufacturers	23 countries	Supplier integration Customer integration Performance	CFA EFA ANOVA Quartiles	Arcs of integration: an international study of supply chain strategies	The widest degree of arc of integration with both suppliers and customers had the strongest association with performance improvement
Rai *et al.* (2006)	Survey Mailed + web site	110 Attendees of the conference of the council of logistics management (CLM) Manufacturers	USA	Data consistency Cross-functional application Systems integration Financial flow integration Physical flow integration Information flow integration Operational excellence Revenue growth Customer relationship Consumer demand Predictability Firm size	SEM-PLS (partial least square) EFA Path analysis	Firm performance impacts of digitally enabled supply chain integration capabilities	Integrated IT infrastructures enable firms to develop the higher-order capability of supply chain process integration Furthermore, IT-enabled supply chain integration capability results in significant and sustained firm performance gains, especially in operational excellence and revenue growth

H2d. Supply chain integration only within the firm will display the lowest levels of financial performance.

Data collection

In order to assess the scope of supply chain integration and to test these hypotheses, data was collected through a mail survey of Swedish manufacturing companies. The survey was developed in two stages. In the first stage, we identified pertinent measures of supply chain integration drivers and performance from the literature and drafted the instrument.

In the second stage, we tested the instrument with supply chain practitioners and academicians. The feedback from these experts was incorporated during the revision of the instrument used in the study.

Data were collected from a stratified random sample of internationally active manufacturing companies from across Sweden. The research design proportionally represented large and small companies; all regions of Sweden were sampled. As a result, a sample of 1,000 viable and internationally active manufacturing companies was drawn. The manufacturing sector has been the main engine of the Swedish economy and accounts for more than half of its GDP (Statistics-Sweden, 2008). Typical respondents were logistics managers and vice presidents of operations or general managers. The industry breakdown of the sample is shown in Table II. The total number of responses after was 296 (29.6 percent). However, total number of usable responses was 271 (27.10 percent).

To determine the presence of non-response bias, early and late respondents were compared on key variables using a *t*-test procedure with the assumption of both equal and unequal group variances. No significant differences were found; thus, a non-response bias does not exist.

Construct validation

All constructs in this study were measured with multi-item scales. Appendix shows the specific items that were used in this study. To assess the validity of the measures, item-to-total correlations were first calculated for each anticipated construct to appraise its internal validity. The correlation coefficients were all high in the expected direction and significant at the 0.01 level. However, three items (SUPP_INTEG_1,

Sector	Count	%
Automotive	14	5.2
Chemicals	29	10.7
Computers/soft and hardware	55	20.3
Food/beverages	15	5.5
Furniture/household	1	0.4
Industrial products	42	15.5
Medical products	18	6.6
Other manufacturing	40	14.8
Paper	19	7.0
Mixed industries	38	14.0
Total	271	100

Table II. Respondents breakdown based on the company's primary product

SUPP_INTEG_5, and SUPP_INTEG_6) from supplier integration that had correlation coefficients lower than 0.5 were dropped since they were not expected to properly reflect their latent construct (Garson, 2007).

The construct validity of the instrument was evaluated by principal component analysis (varimax rotation with Kaiser Normalization). As illustrated in Table III, two principal component analyses were performed – one for the dependent and the other for the independent variables. All items were loaded on their related factor with loadings above 0.64, which is above the recommended threshold of 0.55 (Falk and Miller, 1992). The independent constructs (supplier integration, integration within firm, and customer integration) together explained 65.3 percent of the variance with eigenvalues higher than 1. The dependent construct (financial performance) explained 66.6 percent of the variance with an eigenvalue of 3.99.

These numbers demonstrate the existence of a robust structure. Cronbach's α values were also calculated to evaluate the reliability of the constructs. All are above the suggested threshold of 0.70 (Nunnally, 1994). With respect to descriptive statistics

Measures	Rotated component matrix (a) 1	2	3	Cronbach's α	Mean	SD	Skewness	Kurtosis
Internal integration[a]				0.847				
INT_INTEG4	0.801				5.19	1.495	−0.752	−0.455
INT_INTEG5	0.808				5.04	1.488	−0.664	−0.545
INT_INTEG3	0.790				5.11	1.575	−0.902	0.075
INT_INTEG2	0.774				5.07	1.868	−0.752	−0.223
INT_INTEG6	0.710				4.54	1.958	−0.459	−1.021
INT_INTEG1	0.692				5.19	1.675	−0.455	−0.254
Customer integration[a]				0.811				
CUST_INTEG_4		0.774			3.76	1.580	0.044	−0.749
CUST_INTEG_5		0.748			4.21	1.671	−0.412	−0.509
CUST_INTEG_2		0.718			4.34	1.845	−0.098	−1.014
CUST_INTEG_6		0.679			3.91	1.664	0.015	−0.998
CUST_INTEG_1		0.660			3.38	1.822	0.595	−0.881
CUST_INTEG_3		0.651			4.78	1.629	−0.274	−0.445
Supplier integration[a]				0.791				
SUPP_INTEG_3			0.839		3.55	1.448	0.098	−1.104
SUPP_INTEG_4			0.818		3.48	1.201	0.048	−0.991
SUPP_INTEG_2			0.744		3.71	1.320	0.101	−1.005
Eigenvalues	5.99	2.87	1.99					
% of variance explained	28.4	25.2	19.3					
Financial performance[b]		1		0.841				
FIN_PERF_3		0.829			4.75	1.305	0.045	−0.066
FIN_PERF_2		0.817			4.50	1.119	0.089	0.981
FIN_PERF_4		0.801			4.29	1.001	−0.038	0.554
FIN_PERF_6		0.775			4.84	1.441	−0.187	−0.035
FIN_PERF_5		0.740			4.72	1.554	−0.121	−0.084
FIN_PERF_1		0.659			4.17	1.109	0.095	−0.022
Eigenvalues		4.108						
% of variance explained		69.41						

Note: Significant value of superscripts a and b is $p < 0.01$

Table III.
Principle component analysis, Cronbach's α, and descriptive statistics

of the employed measures, the mean values fall between 3.48 and 5.19, which is more to the middle of the scale spectrum (seven-point semantic differential rating scale was used for all items).

The standard deviation in each case is relatively low ranging between 1.0 and 1.96. The skewness and kurtosis statistics provide evidence of the normality of the data.

All values for skewness are within the recommended range of -1 and $+1$ and the values for kurtosis fall within the suggested range of -3 and $+3$ (Hair *et al.*, 2003).

Data analysis and results

SPSS software was used to test the hypotheses developed for the study. To assess the extent of supply chain integration on the financial performance as reported by the respondents, a series of simple regressions were performed. For each analysis, the independent variable was comprised of different overall composite integration scores. Financial performance was used as the dependent variable as shown in Table IV.

The findings show support for *H1a* indicating that the relationship between total supply chain integration (calculated as a second order construct consisting of the summed average scores for within firm, customer and supplier integration) on a firm's financial performance is positive with an R^2 of 0.383, and is statistically significant at $p < 0.01$. With regard to *H1b*, Table V shows that there is a significant relationship between upstream supply chain integration (calculated as the summed averages of within firm and supplier integration) and financial performance, with an R^2 of 0.305, significant at $p < 0.01$. Therefore, firms that only have upstream supply chain integration will also achieve financial profitability relative to their competitors, thus *H1b* is accepted. The results also support *H1c*, showing that there is a significant relationship between downstream supply chain integration (calculated as the summed averages of within firm and customer integration) and financial performance with R^2 of 0.278. Finally, the test results indicate that the effect of internal supply chain

		Financial performance				
Supply chain integration	SE	Standardized coefficient	*t*-value	R^2	Adjusted R^2	*F*
Supplier-firm-customer	0.089	0.524	5.981	0.383	0.377	40.41
Supplier-firm	0.085	0.471	5.211	0.305	0.298	35.61
Firm-customer	0.079	0.456	5.001	0.278	0.271	30.39
Within firm	0.069	0.435	4.701	0.251	0.245	28.45

Note: All relationships were significant at: $^{*}p < 0.01$

Table IV.
The degree of supply chain integration and performance*

Type of supply chain integration	R^2	β	Rank
Total supply chain integration	0.38	0.52	1
Upstream supply chain integration	0.31	0.47	2
Downstream supply chain integration	0.28	0.46	3
Within firm supply chain integration	0.25	0.44	4

Note: All relationships were significant at: $^{*}p < 0.01$

Table V.
Comparison between level of supply chain integration and financial performance*

integration on a firm's financial performance is positive; however, this is the lowest among the investigated relationships as shown in Table IV, with an R^2 of 0.251, thus *H1d* is supported.

In order to test hypotheses *H2a* through *H2d* and to assess the relative performance outcome of different levels of supply chain integration, the squared correlation coefficients (R^2) and the standardized regression coefficients (β) were compared among all four regression tests. The findings, as illustrated in Table V, provide support for these hypotheses.

The results indicate that the strongest relationship exists between total supply chain integration and financial performance; in comparison, internal integration has the weakest relationship.

Conclusions

This study investigates how supply chain integration can affect the financial performance of manufacturing firms in Sweden. The results provide insights into the degree of integration at various stages of the supply chain system thus providing supply chain managers with informed feedback on the importance of supply chain integration and its benefits. It must be noted that supply chain integration requires a well thought-out strategic plan and commitment from top management. Supply chain strategy must consider the integration of internal processes within the organization and plan for linking these processes with those of the supply chain members in order to attain the full benefits of integration. In addition, supply chain integration requires a carefully developed implementation strategy that identifies the importance of all inter-relationships among different parts of the supply chain (Stevens, 1989; Slater and Narver, 1996).

The degree of integration and its benefits were assessed at four different levels from the most basic integration (internal) to the highest (supplier to customer). As expected, the results show that respondents with basic supply chain integration reported the lowest level of financial benefits in the group, while those with total supply chain integration benefited the most. The results also show that any move from the internal toward external integration of the supply chain in either direction (suppliers or customers) increases the financial performance of the firm. This study has some limitations. First, the variety of industries in the study restricts the value of the data to a macro study; the data should not be used as a benchmark for any particular industry. Second, the study evaluated the impact of SC integration on all manufacturers without regard to the size of the manufacturer. Further research should consider these limitations and explore the impact of supply chain integration on other performance measures in organizations.

There is no doubt that manufacturing firms benefit from supply chain integration both financially and strategically. Consequently, managers should develop strategies to achieve a high level of integration with their suppliers and customers. The implementation of such strategies will require a considerable amount of capital and time; however, the long-term payoff is significant (Krajewski and Ritzman, 2002). Although the study's findings need replication to further confirm the results, manufacturers who only have the basic level of integration should consider planning for further integration to reduce their operational costs and enhance their financial performance and competitive position. Failure to do so may cause a company to forfeit part or all of its market share. Other studies (Lee and Billington, 1992; Hammel and Kopczak, 1993; Frohlich and Westbrook, 2001) voice similar concerns and warn about the dangers of fragmented conventional supply chains.

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Appendix. Items used to measure constructs

1. Independent measures

1.1. Supplier integration.

SUPP_INTEG_1: Information exchange with suppliers through internet or web-based technologies.

SUPP_INTEG_2: Level of strategic partnership with suppliers.

SUPP_INTEG_3: Participation level of suppliers in the design stage.

SUPP_INTEG_4: Participation level of suppliers in the process of procurement and production.

SUPP_INTEG_5: Establishment of quick ordering system.

SUPP_INTEG_6: Stable procurement through network (e.g. EDI).

1.2. Internal integration.

INT_INTEG_1: Data integration among internal functions through network.

INT_INTEG_2: Real-time inventory management.

INT_INTEG_3: Real-time access to logistics-related information.

INT_INTEG_4: Data integration in production processes.

INT_INTEG_5: Cross-functional teams information exchange.

INT_INTEG_6: Online interaction between production and sales functions.

1.3. Customer integration.

CUST_INTEG_1: Integrated demand forecasting.

CUST_INTEG_2: Online order taking.

CUST_INTEG_3: Speed of ordering process.

CUST_INTEG_4: Customer profiling.

CUST_INTEG_5: After-sales service support.

CUST_INTEG_6: Follow-up with customers for feedback.

2. Dependent measure
2.1. Financial performance.
FIN_PERF_1: Total cost reduction.
FIN_PERF_2: Return on investment.
FIN_PERF_3: Return on sales.
FIN_PERF_4: Return on assets.
FIN_PERF_5: Financial liquidity.
FIN_PERF_6: Net profit.

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