Supply Chain Integration: Cluster Analysis of the Impact of Span of Integration.

Vijay R. Kannan
Keah Choon Tan

ABSTRACT

Purpose: To explore whether firms that integrate only with partners adjacent to them in the supply chain exhibit different patterns of supply chain practice and performance than those that also integrate with partners more distant in the supply chain.

Methodology: Cluster analysis of survey data is used to partition firms based on the span of the supply chain involved in their integration efforts.

Findings: Firms with a broad span of integration have a greater focus on alignment with suppliers and customers, and have more of a supply chain focus than those with a narrow span. They also demonstrate higher levels of performance attributable to supply chain relationships.

Practical Implications: Results highlight the importance to supply chain professionals of taking a broad view of the supply chain rather than focusing only on first tier suppliers and customers. They also suggest the importance of exploring opportunities to facilitate broader participation in supply chain integration efforts.

Originality: Past research has identified the importance of supply chain integration without addressing the importance of how much of the supply chain should be involved in such efforts. This study provides empirical support for the need to involve partners across the supply chain.

Keywords: Supply Chain Integration, Empirical Methods, Cluster Analysis.

INTRODUCTION

Supply chain integration (SCI) can be broadly defined as the extent to which supply chain members work cooperatively together to achieve mutually beneficial outcomes (O'Leary-Kelly and Flores, 2002). SCI continues to be a key theme amongst those seeking to understand how to harness the potential of the supply chain to create sustainable value. The notion of leveraging linkages within the supply chain is not new and can be traced to Porter's Value Chain Model that identified the importance of exploiting both intra and inter firm linkages (Porter, 1985). In recent years however, interest has been heightened as firms seek to establish a competitive advantage in an increasingly competitive, dynamic global marketplace. Academics too are increasingly drawing upon a rich theoretical basis with roots in decades of literature in economics, organizational theory, and lean systems/reengineering (Jayaram et al., 2004) to better understand what motivates integration and how to implement it successfully.

Several authors have alluded to evidence suggesting that more is better than less when it comes to SCI, and to the consequences of not fully integrating (e.g., Frohlich and Westbrook, 2001; Vickery et al., 2003). A key question however is what does it mean to be more or fully integrated? Until recently, the research has focused on either direct upstream or downstream integration, exploring either the integration of *immediate* suppliers or customers into decision making processes. Frohlich and Westbrook (2001) extended the discussion by simultaneously examining upstream and downstream integration in the context of forward physical flows and backward information flows. While theirs and subsequent studies have demonstrated the importance of taking a broader view of integration, they do not address the issue of the breadth of the supply chain that should be involved in integration efforts.

Recognition of the need to integrate broadly across the supply chain is not new (e.g., Prahalad and Hamel, 1994; Hammer, 2001). Indeed, several definitions of supply chain management refer explicitly to the entire supply chain from acquisition of basic raw materials to the consumption of finished products. For example, Lambert (2004) defines supply chain management as the "cross functional integration within the firm and across the network of firms that comprise the supply chain". Mentzer (2001) made the distinction between direct supply chains that include a focal firm and a supplier and customer, extended supply chains that include second tier suppliers and customers, and ultimate supply chains that encompass the entire supply chain. Despite definitions such as these, the literature has been slow to empirically examine the impact of integration across a broader swath of the supply chain. Indeed, using Mentzer's (2001) characterization, it is apparent that the literature has either focused on direct supply chains or failed to clearly articulate otherwise.

Our intent is to extend the discussion of integration to explicitly incorporate firms beyond first tier suppliers and customers. Specifically, we examine whether performance benefits accrue to firms that involve extended supply chain partners, and whether the integration practices of these firms differ from those that engage only with immediate supply chain partners. We provide an alternative interpretation of what 'more' integration means by exploring the breadth of the supply chain involved rather than the intensity of integration over a narrow span of the supply chain.

INTEGRATION: EXTENT AND PERFORMANCE

In a recent survey of the performance implications of supply chain integration, van der Vaart and van Donk (2008) revealed two key issues. First, much of the literature focuses on relationship development and/or firm orientation towards holistic, long term decision making processes rather than integration per se. Indeed, this is borne out by their classification of prior

research based on patterns of inter-firm interaction, attitudes of firms towards partners, and use of practices that enable collaboration. Second, while there is ample evidence of the beneficial impact of integration on performance, it is hard to generalize from the literature due to ambiguity in how integration is defined, operationalized, and measured. Given the largely supportive evidence of a positive relationship between integration and performance, the current focus is explicitly on the relationship between extent of integration among supply chain members and its performance benefits[1]. Extent of integration is operationalized in terms of 'more versus less' integration as characterized by the various authors of pertinent research is summarized (Table 1).

Frohlich and Westbrook (2001) coined the expression 'arcs of integration' to characterize the extent to which firms integrated with upstream and downstream supply chain partners. They observed that firms with the greatest arcs, those with the most extensive integration with both suppliers and customers, demonstrated the greatest improvements in several measures of financial, productivity, and non productivity based performance. Building on this work, Rosenzweig et al., (2003) explored the relationship between integration intensity, competitive capability, and performance. They observed that integration intensity is positively related to quality, delivery, process flexibility, and cost capability. Moreover, they found positive relationships between integration intensity and new product revenues, return on assets, and customer satisfaction. In applying the 'arcs of integration' concept to a comparison of U.S. and East Asian firms, Zailani and Rajagopal (2005) not only corroborated the results of Frohlich and Westbrook, they showed that they held in an East Asian context.

Narasimhan and Kim (2002) examined the impact of internal, supplier, and customer integration on product diversification and international market diversification. They observed that

[1] For a comprehensive review of the literature on integration, readers are directed to van de Vaart and van Donk (2008).

integration with suppliers and customers positively moderates the relationship between international market diversification and performance. Specifically, they concluded that integration could extend the point of diminishing returns of product and market diversification over time. They also showed that the moderating effect of international market diversification on the relationship between product diversification and performance becomes insignificant as the level of internal, customer, and supplier integration increases.

Droge et al., (2004) explored internal and external integration in the context of design processes and their impact on product development time, product cycle time, and responsiveness. They observed that both internal and external integration exhibit positive relationships with all three measures of time based performance. Bagchi et al., (2005) operationalized integration in terms of the frequency of participation with key suppliers and customers and the breadth of functional groups engaged. Not only did they identify differences in degree of integration with suppliers versus customers, they identified variations in where within the organization integration was taking place. Moreover, they found evidence of significant positive relationships between integration with suppliers with regard to supply chain design, inventory control, sales administration, research and development, and procurement, as well as with customers with regard to production, and various measures of performance.

Kim (2006a) examined the impact of the level of integration on the interaction between corporate competitive capability and supply chain operational capability, and how these affect performance. Corporate competitive capability was operationalized in terms of cost leadership, customer service, innovative marketing technology, and differentiation, while supply chain operational capability was operationalized in terms of technical, structural, and logistical capability. Support was found for the hypothesis that as the level of integration increases,

significant interactive effects diminish. They speculated that internal and external sharing of resources and technological knowledge reduces the need for firms to internalize supply chain operational capability. Kim (2006b) observed that among large firms, the level of integration has a positive influence on corporate competitive capability and firm performance, but that among small firms, this is true only with respect to performance. Lee et al., (2007) examined the relationship between strong internal, customer, and supplier linkages, and supply chain cost containment, performance reliability, and overall performance. Cost containment was measured in terms of logistics related costs while performance reliability was measured in terms of inventory performance. They observed that all three linkages were positively related to overall performance and performance reliability, and that strong internal and supplier linkages were positively related to cost containment.

Using Fisher's categorization of functional versus innovative supply chains (1997), Ramdas and Spekman (2000) observed that innovative supply chains are more closely integrated than functional supply chains with respect to planning and control, quality management, and service and after sales support. They also noted that suppliers are more proactive in high performing innovative supply chains than those in functional supply chains. Moreover, high performing firms in innovative supply chains use more integrating mechanisms.

Insert Table 1

RESEARCH HYPOTHESES

It is apparent that while the literature talks about the need to integrate broadly across the supply chain, evidence from empirical studies leads to the conclusion that being 'more' integrated has been viewed only in terms of the intensity of integration. For those partners with whom the

focal firm is integrated, it is better to have a high rather than a low level of integration, as characterized by communication, information exchange, and engagement. However, discussion of how much of the supply chain is involved in these efforts and its impact is scarce. This is a significant shortcoming in the literature. Power (2005) stated that 'recognition of the inter-dependence of all partners in a supply network appears to be an important precursor of effective integration'. Zailani and Rajagopal (2005) added 'the need to realize and recognize the interrelationships among different parts of the supply chain is critical in order to gauge the competitive advantage.' Frankel et. al., (2008), in analyzing future opportunities for supply chain management research, referred to the importance of increased supply chain length, and by implication, the need to incorporate supply chain length in future research. We address this by examining the span of supply chain integration. Span is defined in terms of the proximity of firms within the supply chain involved in their integration efforts to the focal firm, i.e., are firms 1st, 2nd tier suppliers/customers etc, and whether other supporting firms such as logistics providers are involved (Figure 1). A firm with a narrow span of integration will tend to include only itself and immediate supply chain partners in its efforts to manage the supply chain, while a firm with a broad span will tend to also include firms beyond immediate partners. Sezen (2008) appears to be the only study to date that explicitly identified where in the supply chain relative to the focal firm responding firms lay. However this was not incorporated into research questions or subsequent analysis. As past literature has implied but not evaluated, what is referred to in the current study as the span of integration, is key to integration efforts. Consistent with this, the underlying premise of the current study is that a firm's commitment to engaging firms from a broad rather than narrow spectrum of the supply chain implicitly communicates differences in their commitment to building inter firm linkages. Building such linkages facilitates product development, manufacturing and

delivery efforts, which in turn has implications for quality, increased responsiveness to market changes, and the reduction of waste from the supply chain. This in turn will have implications for broader measures of financial and market performance. We explore two hypotheses:

Hypothesis 1: *Span of integration is positively related to commitment to building inter-firm linkages.*

Hypothesis 2: *Span of integration is positively related to firm performance.*

Our objective is not to explore the issue of causality. In other words we do not explore whether the building of inter firm linkages is a precursor to broadening the span of integration. Rather, our goal is to examine whether firms that have a broad span of integration differ from firms that focus on narrow span of integration with regard to integration-focused activities.

Insert Figure 1

Given the lack of a precise definition or standard operationalization of SCI (van der Vaart and van Donk, 2008), we rely on constructs of integration for which there appears to be acceptance in the literature. Four dimensions of integration are considered. A customer and a supplier focus to integration (e.g., Frohlich and Westbrook, 2001; Narasimhan and Kim, 2002) are included to reflect integration efforts focused on specific (upstream and downstream) sides of the focal firm. The literature in a number of domains including supply chain management and quality management, have repeatedly addressed the need to engage both suppliers and customers in decision making process. Capturing customer expectations and using this to influence product development, manufacturing, and supply processes, are core drivers of sustainable value. In addition, a supply chain focus and an information focus are considered. Consistent with the underlying principle that integration should encompass the entire supply chain (e.g., Prahalad and

Hamel, 1994; Hammer, 2001), we include supply chain focus as a construct that captures efforts to integrate beyond immediate suppliers or customers alone. While firms may adopt specific tactics to facilitate integration with suppliers or with customers, they will need to adopt additional tactics to communicate a desire and willingness to integrate more broadly. As prior studies have demonstrated, information flows throughout the supply chain are a key element of integration efforts (e.g., Frohlich and Westbrook, 2001). This suggests the need to develop the requisite information sharing infrastructure. Prior studies have demonstrated that this can facilitate, stabilize, and/or enhance coordination between buyers and suppliers (Bensaou & Anderson, 1999, Chae, et al., 2005, Kim et al., 2006. Recognizing this, we treat information focus as a separate construct.

Given these constructs, hypothesis 1 can be restated as four sub-hypotheses that reflect the relationship between span of integration and each of the constructs separately:

Hypothesis 1a: Span of integration is positively related to customer focus.

Hypothesis 1b: Span of integration is positively related to supplier focus.

Hypothesis 1c: Span of integration is positively related to supply chain focus.

Hypothesis 1d: Span of integration is positively related to information flow focus.

Performance is defined at two levels. Prior studies have demonstrated the need to differentiate between firm level performance outcomes and relationship level outcomes (e.g., Kannan and Tan, 2006). Performance measures related to quality, lead time, cost, and overall financial and market related performance implicitly incorporate the effects of factors other than those related to managing the supply chain itself. Since the objective here is to explore the effects of integration and of leveraging supply chain relationships, it is pertinent to also consider how successful these efforts are. Consistent with past research (e.g., Benton and Maloni, 2005; Kannan

and Tan, 2006), we use buyer perceptions of relationship impact as a measure of relationship performance. This results in the two sub hypotheses:

Hypothesis 2a: Span of integration is positively related to relationship performance.

Hypothesis 2b: Span of integration is positively related to firm performance.

RESEARCH METHODOLOGY

Survey Development

Data was collected using a survey of practicing managers in the U.S. and Europe identified from membership lists of the Institute of Supply Management and the Association of Operations Management. To assess the four dimensions of supply chain integration, survey respondents were asked to indicate the importance of various practices in their integration efforts using a five-point Likert scale (1 = not important, 5 = very important, Appendix 1). Practices included in the survey were identified from the literature and from discussions with industry professionals. Relationship performance was assessed by asking respondents to evaluate the success of their firm's partnerships with suppliers with respect to four dimensions of performance. Firm performance was assessed by asking respondents to indicate their firm's performance relative to that of major industrial competitors on four measures of market and financial performance. The survey also asked about the participants in the responding firm's supply chain management efforts. Participants were classified as 1^{st} , 2^{nd}, or 3^{rd} tier suppliers and customers, other service providers, and the firm itself. Respondents were asked to identify each participant using this scheme. After pre-testing and revision, the survey instrument was distributed to 2,900 respondents using standard mail survey procedures (Dillman, 1978). The survey yielded 321 responses (response rate = 11.1%). To test for the presence of non-response bias, responses to a randomly selected set of questions and firm characteristics were compared for early versus late returned responses, the latter

considered representative of non-respondents (Lambert and Harrington, 1990). No significant differences between the two groups suggested the absence of non-response bias in the data. Responding firms included raw material fabricators (6% of sample), and component (24%) and final product (70%) manufacturers, and ranged in size from 100 or fewer employees (10% of sample) to over 5,000 (10% of sample). Median firm size was 500 employees. Annual sales of responding firms ranged from less than $5 million (7% of sample) to over $1 billion (22%) with a median of $100 million.

Data Analysis

Hierarchical cluster analysis was used to partition respondents into groups based on the span of their supply chain integration. Responses to the question on participants in the firm's supply chain management efforts (see Appendix) were used to carry out the clustering. Each of the nine categories of supply chain participant was used as a separate variable, respondents having indicated which individual categories were pertinent to their supply chain. The median linkage clustering method was used and data was standardized so that all the variables were on the same scale and equally weighted. Two, three, and four-cluster classification solutions were tested. The three and four-cluster classifications each yielded a small cluster of 14 cases. The two-cluster classification however split the sample into two clusters consisting of 101 and 120 cases for the first and second cluster respectively[2] (Table 2). Dendrograms of the analysis suggested that two clusters are appropriate for the data. Closer examination of the two-clusters revealed that the first cluster consisted of firms that included only immediate (1st tier) suppliers and/or customers in their efforts to manage the supply chain, whereas the second cluster consisted of firms that included

[2] Surveys that failed to identify the participants in their firm's supply chain management efforts are excluded from the cluster analysis.

supply chain partners beyond 1st tier suppliers and/or customers. Hence, the first cluster is considered to be representative of firms with a narrow span of integration whereas the second cluster is considered to be representative of firms with a broad span of integration. The two-cluster classification scheme was thus used in all subsequent analysis.

Insert Table 2

For each construct, Cronbach's α (Cronbach, 1951) was used to assess scale reliability. With one exception, values of α were well in excess of 0.70 (Table 3) and can thus be considered to be reliable (Nunnally, 1988). However, the value of α = 0.665 for the information focus scale still exceeded the threshold of 0.60 considered acceptable for exploratory empirical research.

Factor analysis was used to reduce the measured variables or indicators into the appropriate constructs. The principal components analysis method was used with Varimax rotation and Kaiser normalization. Factor scores using the regression method were saved for subsequent analysis. The eight indicators that measure customer focus grouped into a single factor that explained about 45% of variance in the data. Factor loadings all exceeded 0.50 (Nunnally, 1988). The Kaiser-Meyer-Olin (KMO) measure of sampling adequacy and Bartlett test of sphericity validated the appropriateness of using factor analysis. Similarly, the seven indicators for supplier focus, seven indicators for supply chain focus, and four indicators for information focus, each grouped into single factors that accounted for 45%, 50%, and 50% of variance in the data respectively. In each case, factor loadings again exceeded 0.50, and the KMO measure and Bartlett's test supported the use of factor analysis.

Insert Table 3

Independent sample t-tests were conducted to explore differences between the two clusters with respect to integration efforts and performance. Factor scores were used for the four integration constructs, and responses to the specific variables were used for relationship and firm performance. Levene's test for equality of variances indicated that equality of variances between the two clusters could be assumed.

Results

Results showed that differences between firms (broad span of integration - narrow span of integration) are statistically significant for all four integration constructs ($\alpha = 0.01$, Table 4). This provides support for hypotheses 1a-d, and suggests that firms that embrace a broad spectrum of supply chain partners in their integration efforts do in fact have a stronger emphasis on building inter-organizational linkages than firms that include, at best, only 1st tier suppliers and/or customers. The supplier and customer focus constructs yielded the highest t-values. This can be explained by efforts to build linkages with individual suppliers and customers preceding broader supply chain development efforts, and thus being relatively more mature. Results for relationship performance suggest that supply chain relationships have a greater positive impact on improvements in sales ($\alpha = 0.01$), new product development time ($\alpha = 0.05$), and quality ($\alpha = 0.10$) for firms with a broad span of integration than those with a narrow span of integration. A broad span of integration is consistent with taking a strategic rather than a merely tactical view of the supply chain, thereby leveraging the collective expertise and capabilities of supply chain partners. This suggests a focus on activities that create value such as, for example product development and quality. The resulting increase in attractiveness of products to customers is reflected in increases

in sales. There is however no statistically significant difference with respect to cost reduction. This is somewhat surprising since reductions in cost would also be expected to result from taking a broad view of the supply chain. A possible explanation is that firms with a broad span of integration have a value added focus as indicated above rather than a cost reduction focus. It might also be a reflection of costs not decreasing as a result of product improvements. In summary, only partial support is provided for hypothesis 2a. The only measure of firm performance for which there is a statistically significant difference attributable to span of integration is customer service level ($\alpha = 0.05$), again providing only partial support for hypothesis 2b. This is a somewhat surprising outcome. A broad span of integration would be expected to positively impact multiple measures of firm performance. A possible explanation for the observed result is that improvements in customer service are a direct reflection of improved quality and speed to market. These enable a firm to respond more effectively to customer expectations. In contrast, market share, return on assets, and competitive position are broader measures of performance and are influenced by factors beyond the supply chain alone. For example, a firm's efforts to broadly engage supply chain partners may not result in performance improvements relative to competitors if they are matched by those of competitors. Indeed, a broad span of integration may be a response to actions taken by its competitors.

Insert Table 4

DISCUSSION

The results provide important insights into what it means to be more integrated within the supply chain. Unlike prior studies that demonstrate that the intensity of integration has a positive impact on performance, the results here illustrate that how much of the supply chain is engaged in

integration efforts also plays a role. While the importance of involving participants from across the supply chain has been alluded to in both the supply chain (e.g., Power, 2005; Zailani and Rajagopal, 2005; Frankel et. al., 2008), and management (e.g., Prahalad and Hamel, 1994, Hammer, 2001) literature, until now there has been no supporting empirical evidence. The results demonstrate that firms with a broad span of integration differ in their integration efforts from firms that focus on narrow span on multiple dimensions. This is consistent with Mentzer's (2001) distinction between direct, extended, and ultimate supply chains. Not only do firms with a broad span of integration attach greater emphasis to facilitating chain wide integration efforts, they do so with regard to integration with suppliers and customers alone. The specific practices explored with respect to supplier and customer integration did not make a distinction as to whether partners were 1st tier, 2nd tier or beyond. However, to the extent that firms typically focus on immediate suppliers and customers, the result is significant in that it suggests that firms with a broad span are more focused on even these customers and suppliers than those with a narrow span.

The results regarding performance are important in that they demonstrate the positive impact of a broad span of integration on relationship based outcomes as well as improvements in customer service. The observation that firms with a broad span of integration outperform those with a narrow span may be an indication that there is value in terms of reduced product development time, and higher sales and quality from building relationships with suppliers beyond the 1st tier. Alternatively, it may be an indication that reaching out to supply chain partners beyond the 1st tier indicates a greater willingness and commitment to engaging partners in a cooperative, collaborative manner than reaching out to 1st tier suppliers and customers alone. It may also suggest that firms with a broad span of integration have more established mechanisms to leverage supply chain relationships than those with a narrow span of integration. Whatever the reason, the net result

is that there is value associated with broader rather than narrower engagement. This complements the results of Frohlich and Westbrook (2001) and others who have made the case for the need for greater intensity of integration.

The importance of span of integration can be illustrated using the so called 'bullwhip' effect (Lee et al., 1997). At each interface in the supply chain, ineffective exchanges of information lead to information distortion, inaccurate interpretation of communication, and thus poor decision making. Firms with a broad span of integration can overcome these challenges since they are not only better positioned to receive signals directly from the source rather than through intermediaries, they have richer context with which to correctly interpret and act on these signals. Moreover, they receive signals in a timely manner. In contrast, firms with a narrow span of integration typically not only received less complete information, they must interpret it absent appropriate context, and in a less timely manner.

The managerial implications of the results can be illustrated by Wal-Mart's Remix initiatives to exploit supply chain integration (Hoffman, 2006). In an attempt to improve in-stock position and inventory turnover, Wal-Mart limited inventory growth to one-half of sales growth. They reduced order sizes and asked suppliers to deliver more frequently to Wal-Mart distribution centers. However, smaller order sizes increased the number of less-than-truckload shipments from vendors, thereby creating congestion at the distribution centers. Wal-Mart extended its span of integration by incorporating third party logistics providers who consolidated less-than-truckload shipments from multiple vendors into truckload shipments at five strategically located consolidation centers throughout the U.S. This eased congestion at the distribution centers as well as yielded additional shipping efficiencies.

CONCLUSION

This study adds to the literature by examining the span of supply chain integration, patterns of integration practice, and implications for performance. It provides important insights into what it means to be more integrated, and highlights the need for firms to engage the supply chain broadly. The results also highlight opportunities for further exploration of the concept of supply chain integration. While they demonstrate the positive impact of a broad span of integration, the results do not provide specific cues as to what explains these differences. The intent of the current study was in part to explore whether span of integration contributes to performance differences. Having established this, the logical next step is to gain better insight into what it is about firms with a broad span of integration that explains these performance differentials. A limitation of the current sample is that it yielded only two clusters. The implication is that within each cluster, firms were not homogeneous with respect to span of integration. Greater insight into the span of integration could be obtained if a larger sample enabled more clusters to be identified, each of which was more internally homogeneous. This in turn may enable specific relationships between span and specific performance measures to be identified. Another area for extension relates to the issue of causality. The current study identifies the existence of relationships between span of integration and supply chain practice, particularly with regard to intra-chain linkages. However, whether the building of inter firm linkages is a precursor to broadening the span of integration or having a broad supply chain perspective drives the development of these linkages, is an important question. This has ramifications for firms at different stages of maturity and supply chain development that need to be better understood. The impact of culture, both national and organizational, also merits further attention. As documented in the literature, differences in group versus individual orientation have been observed between countries in, for example, North America and Europe, and Asia. This is significant in the context of supply chains since it speaks to the question of

whether one should act in a firm's best interests or those of a broader system. This in turn shapes strategies and tactics that drive supply chain behavior. As competitive forces intensify, the need for firms to leverage their supply chains will increase. Increasing the understanding of how and when to engage supply chain partners will thus take on greater importance.

REFERENCES

Bagchi, P.K., Ha, B.C., Skjoett-Larsen, T., and Soernsen, L.B. (2005), "Supply Chain Integration: A European Study", *International Journal of Logistics Management*, Vol. 16 No. 2, pp. 275-294.

Bensaou, M. and Anderson, E., (1999), "Buyer-Supplier Relations in Industrial Markets: When do Buyers Risk Making Idiosyncratic Investments?" *Organization Science*, Vol. 10 No. 4, pp. 460-481.

Chae, B., Yen, R.H. and Sheu, C. (2005), "Information Technology and Supply Chain Collaboration: Moderating Effects of Existing Relationships between Partners", *IEEE Transactions on Engineering Management*, Vol. 52 No. 4, pp. 440-448.

Cronbach, L.J. (1951), "Coefficient Alpha and the Internal Structure of Tests", Psychometrika, Vol. 16, pp. 297-334.

Dillman D. (1978), *Mail and Telephone Surveys: The Total Design Method*, John Wiley & Sons, Toronto.

Droge, C., Jayaram, J., and Vickery, S.K. (2004), "The Effects of Internal Versus External Integration Practices on Time Based Performance and Overall Performance", *Journal of Operations Management*, Vol. 22, pp. 557-573.

Fisher, M. (1997), "What is the Right Supply Chain for Your Product", *Harvard Business Review*, March-April, pp. 105-116.

Frankel, R., Bolumole, Y.A., Eltantawy, R.A., and Paulraj, A. (2008), "The Domain and Scope of SCM's Foundational Disciplines – Insights and Issues to Advance Research", Journal of Business Logistics, Vol. 29, No. 1, pp. 1. 30.

Frohlich M.T., and Westbrook, R. (2001), "Arcs of Integration; An International Study of Supply Chain Strategies", *Journal of Operations Management*, Vol. 19, pp. 185-200.

Hammer, M. (2001), *The Agenda: What Every Business Must Do to Dominate the Decade*, Random House Business Books, London.

Hoffman, W. (2006), "Mixing it up: Wal-Mart's Latest Strategy for Delivering the Goods Promises to Shake up Other Supply Chains", *Journal of Commerce*, Vol. 7 No. 22, pp. 64a-68a.

Kim, S.W. (2006a), "The Effect of Supply Chain Integration on the Alignment between Corporate Competitive Capability and Supply Chain Operational Capability", *International Journal of Operations and Production Management*, Vol. 26 No. 10, pp. 1084-1107.

Kim S.W. (2006b), "Effects of Supply Chain Management Practices, Integration and Competition Capability on Performance", *Supply Chain Management: An International Journal*, Vol. 11 No. 3, pp. 241-248.

Kim, D., Cavusgil, S.T. and Calantone, R.J. (2006), "Information System Innovations and Supply Chain Management: Channel Relationships and Firm Performance", *Journal of the Academy of Marketing Science*, Vol. 34 No. 1, pp. 40-54.

Lambert, D.M., (2004), *Supply Chain Management: Processes, Partnerships, Performance*, Supply Chain Management Institute, Sarasota, FL.

Lambert, D.M. and Harrington, T.C. (1990), "Measuring Non-Response Bias in Mail Surveys", *Journal of Business Logistics*, Vol. 11 No. 2, pp. 5-25.

Lee, H.L., Padmanabhan, V., and Whang, S., (1997), "The bullwhip effect in supply chains", *Sloan Management Review, Vol. 38 No. 3, pp. 93-102.*

Lee, C.W., Kwon, I.G., and Severance, D. (2007), "Relationship between Supply Chain Performance and Degree of Linkage among Supplier, Internal Integration, and Customer", *Supply Chain Management: An International Journal*, Vol. 12 No. 6, pp. 444-452.

Mentzer, J.T. (2001), *Supply Chain Management*, Sage Publications, London.

Narasimhan, R., and Kim S.W. (2002), "Effect of Supply Chain Integration on the Relationship between Diversification and Performance: Evidence from Japanese and Korean Firms", *Journal of Operations Management*, Vol. 20, pp. 303-323.

Nunnally, J. (1988), *Psychometric Theory*, McGraw-Hill, New York, NY.

O'Leary-Kelly, S.W. and Flores, B.E. (2002), "The Integration of Manufacturing and Marketing/Sales Decisions: Impact on Organizational Performance", *Journal of Operations Management*, Vol. 20 No. 3, pp. 221-240.

Porter, M.E., (1985), *Competitive Advantage: Creating and Sustaining Superior Performance*, Free Press, New York, NY.

Power, D., (2005), "Supply Chain Management Integration and Implementation: A Literature Review", *Supply Chain Management: An International Journal*, Vol. 10. No. 4, pp. 252-263.

Prahalad, C.K., and Hamel, G. (1994), "Strategy as a Field of Study: Why Search for a New Paradigm", *Strategic Management Journal*, Vol. 15, pp. 5-16.

Ramdas, K., and Spekman, R.E. (2000), "Chain or Shackles: Understanding What Drives Supply-Chain Performance", *Interfaces*, Vol. 30 No. 4, pp. 3-21.

Rosenzweig, E.D., Roth, A.V., and Dean J.W. (2003), "The Influence of an Integration Strategy on Competitive Capabilities and Business Performance: An Exploratory Study of Consumer Products Manufacturers", *Journal of Operations Management*, Vol. 21, pp. 437-456.

Sezen, B., (2008), "Relative Effects of Design, Integration and Information Sharing on Supply Chain Performance", *Supply Chain Management: An International Journal*, Vol. 13 No. 3, pp. 233-240.

Van de Vaart, T., and van Donk, D.P. (2008), "A Critical Review of Survey-Based Research in Supply Chain Integration", *International Journal of Production Economics*, Vol. 111, pp. 42-55.

Zailani, S., and Rajagopal, P., (2005), "Supply Chain Integration and Performance: U.S. versus East Asian Companies", *Supply Chain Management: An International Journal*, Vol. 10 No. 5, pp. 379-39.

Appendix: Survey Items

Participants in Supply Chain Management Efforts

1. Firm only
2. 1st tier suppliers
3. 2nd tier suppliers
4. 3rd tier suppliers
5. 1st tier customers
6. 2nd tier customers
7. 3rd tier customers
8. End customers
9. Others (transportation, warehousing, recycling)

Customer Focus

1. Determination of key factors for improving customer satisfaction
2. Employing a customer satisfaction measurement system
3. Interaction with customers to set reliability, responsiveness, other standards
4. Making it easier for customers to seek assistance
5. Honest and frequent communication
6. Sharing of confidential information
7. Use of EDI
8. Contacting end users of products to get feedback on performance, customer service

Supplier Focus

1. Evaluation of suppliers based on sharing of sensitive information
2. Evaluation of suppliers based on participation in new product development/value analysis
3. Use of early supplier involvement
4. Aiding suppliers in increasing their JIT capabilities
5. Evaluation of suppliers based on use of EDI
6. Communication of future strategic needs to suppliers
7. Participating in sourcing decisions of suppliers

Supply Chain Focus

1. Seeking new ways to integrate supply chain activities
2. Establishing more frequent contact with supply chain members
3. Involving all members of the supply chain in product/service/marketing plans
4. Extending the supply chain to include members beyond immediate suppliers and customers
5. Improving the integration of activities across the supply chain
6. Creating supply chain teams that include members from different companies
7. Creating a greater level of trust among supply chain members

Information Focus

1. Use of informal information sharing with customers and suppliers
2. Communicating customers' future strategic needs throughout the supply chain
3. Use of formal information sharing with customers and suppliers
4. Creating a compatible communication/information system with customers and suppliers

Relationship Performance

1. Sales improvement
2. Quality improvement
3. Cost reduction
4. New product development time reduction

Firm Performance

1. Market Share
2. Return on Assets
3. Overall competitive position
4. Overall customer service level

Table 1: Summary of Prior Literature

Author(s)	Operationalization of Integration	Measurement of Integration
Bagchi et al., (2005)	Functions involved in integration	Degree of involvement (5 point scale: without seeking advice - joint decision making), Frequency/informality of interactions (5 point scale: less than annual - more than quarterly)
Droge et al., (2004)	Internal: concurrent engineering, design for manufacturing, standardization, use of CAD/CAM External: supplier development, supplier partnerships, closer customer relationships.	Internal, External (7 point Likert scale: Extent of Use)
Frohlich & Westbrook (2001)	Planning, packaging, delivery, logistics activities, associated information flows	Supplier, Customer (5 point Likert scale: none – extensive)
Kim (2006a)	Not explicitly articulated	Stage of integration (Independent, related functions, internal, external)
Kim (2006b)	Internal: Information, communication Supplier: Information, participation Customer: Information, communication	Internal, Supplier, Customer (7 point Likert scale: Extremely low – Extremely high)
Lee et al., (2007)	Internal: Information Supplier: Information, participation Customer: Information	Not explicitly articulated
Narasimhan & Kim (2002)	Internal: internal processes, data access/sharing Suppliers: participation/information exchange Customers: communication/information flow	Internal, supplier, customer (7 point Likert scale: Extremely Low-Extremely High)
Rosenzweig et al., (2003)	Not explicitly articulated	Internal, raw material suppliers, distributors/retailers, customers; (5 point Likert scale: none - high)

Zailani and Rajagopal (2005)	Internal: Not explicitly articulated Supplier: involvement, influence of supplier, degree of partnership Customer: involvement, influence of customers, feedback	Not explicitly articulated

Table 2: Hierarchical Cluster Analysis

Cluster	Frequency	Percent	Cumulative Percent
Narrow Span of Integration	101	45.7	45.7
Broad Span of Integration	120	54.3	100.0
Total	221	100.0	

Table 3: Factor Analysis

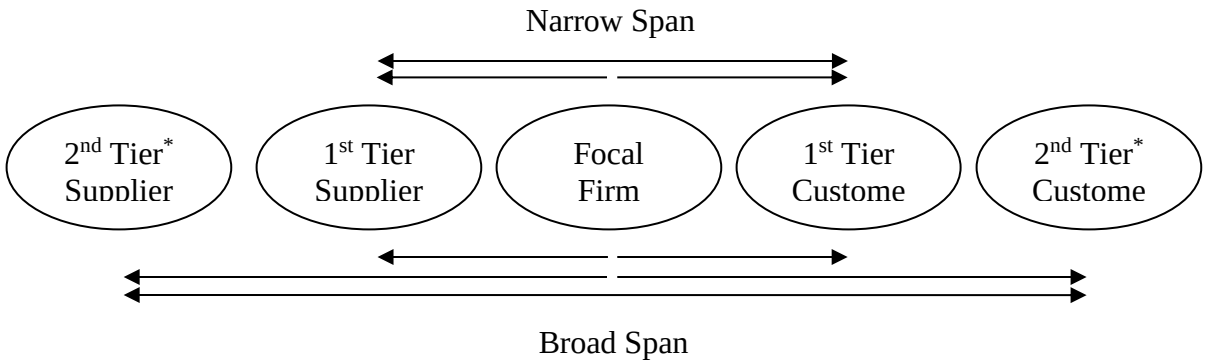
Construct	Items	Loadings
Customer Focus	Determination of key factors for improving customer satisfaction	0.794
	Employing a customer satisfaction measurement system	0.772
	Interaction with customers to set reliability, responsiveness, other standards	0.728
	Making it easier for customers to seek assistance	0.721
	Honest and frequent communication	0.640
	Sharing of confidential information	0.581
	Use of EDI	0.528
	Contacting end users of products to get feedback on performance, customer service	0.521
	Cronbach's α = 0.807, KMO = 0.846 (Bartlett's test of sphericity, $p < 0.05$)	
Supplier Focus	Evaluation of suppliers based on sharing of sensitive information	0.754
	Evaluation of suppliers based on participation in new product development/value analysis	0.736
	Use of early supplier involvement	0.674
	Aiding suppliers in increasing their JIT capabilities	0.667
	Evaluation of suppliers based on use of EDI	0.643
	Communication of future strategic needs to suppliers	0.641
	Participating in sourcing decisions of suppliers	0.547
	Cronbach's α = 0.788, KMO =0.785 (Bartlett's test of sphericity, $p < 0.05$)	
Supply Chain Focus	Seeking new ways to integrate supply chain activities	0.796
	Establishing more frequent contact with supply chain members	0.727
	Involving all members of supply chain in product/service/marketing plans	0.694
	Extending supply chain to include members beyond immediate suppliers and customers	0.693
	Improving the integration of activities across the supply chain	0.688
	Creating supply chain teams that include members from different companies	0.680
	Creating a greater level of trust among supply chain members	0.658
	Cronbach's α = 0 .827, KMO = 0.808 (Bartlett's test of sphericity, $p < 0.05$)	
Information Focus	Use of informal information sharing with customers and suppliers	0.747
	Communicating customers' future strategic needs throughout the supply chain	0.718
	Use of formal information sharing with customers and suppliers	0.714
	Creating a compatible communication/information system with customers and suppliers	0.650
	Cronbach's α = 0.665, KMO = 0.706 (Bartlett's test of sphericity, $p < 0.05$)	

Table 4: Independent Samples T-Test (Equal Variances Assumed)

(I) Factor Scores	T-Test for Equality of Means		
	Mean Difference (Broad-Narrow)	Std. Error of Difference	t-value
Supplier Focus	0.489	0.136	3.59+
Customer Focus	0.434	0.134	3.24+
Information Focus	0.362	0.135	2.68+
Supply Chain Focus	0.383	0.135	2.84+
(II) Relationship Performance			
Sales Improvement	0.523	0.183	2.862+
Quality Improvement	0.272	0.153	1.783^
Cost reduction	0.182	0.156	1.166
New Product Development Time Reduction	0.459	0.195	2.356*
(II) Firm's Performance Relative to Major Industrial Competitors			
Market Share	0.050	0.133	0.378
Return on Assets	0.187	0.125	1.489
Overall Competitive Position	-0.006	0.114	-0.052
Overall Customer Service Levels	0.258	0.104	2.466*

+ denotes statistically significant at α = 1%
* denotes statistically significant at α = 5%
^ denotes statistically significant at α = 10%

Figure 1: Span of Integration



* 2nd Tier and beyond, other supply chain participants