ABSTRACT

Information integration strengthens the relationship between manufacturing firms and other supply chain members. We explore the effects of internal and external information integration on the relationships between manufacturers and their customers and suppliers. The effects of improved customer and supplier relationship on the financial performance of manufacturers are examined too.

KEYWORDS: Information integration, Customer relationship, Supplier relationship, Financial performance

INTRODUCTION

With the continuous improvement to information system and information technology (IT) infrastructures, IT use has played an important strategic role in supply chain management practice (Soroor et al, 2009). Porter and Millar (1985) asserted that IT use leads to internal and external information integration and facilitates the collaboration between supply chain members. Bowersox (1989) argued further that the process integration should progress from the internal logistics integration to external integration by efficient information sharing and strategic linkage with suppliers and customers. In order to meet the increased customer requirement on customization, mass customization strategy is adopted to achieve competitive advantages for a demand-driven manufacturer (Pine 1993). Therefore, it is essential to integrate with customers and enable the manufacturers to recognize the customers’ preference timely and design the products and services accordingly (Lee et al, 2000). Meanwhile, the integration with suppliers including sharing accurate product designs, process improvements, and delivery schedule information timely will support manufacturers to attain strategic goals, operational and financial targets (Tracey et al, 1999; Dean et al, 2009). While it is a straightforward logic, the mechanism and effects of the interactions between supply chain members vary wildly by industry and market. The operational performance improvement resulting from information integration includes feedback to the shop floor, autonomous maintenances, and cellular manufacturing etc. (Liu et al. 2006). Manufacturers also expect these operational advantages will enhance their financial performance resulting from the enablement of customization, an intangible asset of the manufacturers (Huang et al, 2006; Kim and Cavusgil, 2009).

In this study, we investigate how the internal information integration between different business functions and the external information integration with customers and suppliers can enhance the manufacturers’ financial performance. More specifically, we are focusing on
demand-driven manufacturers implementing mass customization strategy which has become the mainstream manufacturing mode.

**LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT**

**Information System Integration (ISI)**

The value of information integration has been investigated from different perspectives in the literature (Bourland et al, 1996; Chen, 1998; Aviv & Federgruen, 1998; Gavireni et al, 1999; Lee et al, 2000; Cachon & Fisher, 2000; Yu et al, 2001; Simchi-Levi & Zhao, 2005; and Croson & Donohue, 2005). In particular, demand information has been used in supply chain coordination to dampen upstream variability propagation, especially under a capacitated and stochastic situation (Balakrishnan et al, 2004; Wijngaard, 2004; Bollapragada & Rao, 2006; and Boute et al, 2007).

ISI integrates diverse information system practices exercised by supply chain members and prioritize into three levels of integration: strategic, operational, and infrastructural. ISI helps firms save costs by eliminating redundant logistic activities, unimportant information system practices, and unnecessary information system investments, which are not contributed to overall performance. With ISI, the proper architecture of hardware, software, networks, applications, and management practices must be integrated with the firm’s business processes and its organizational life (Bourdreau & Couillard, 1999).

Mudie and Schafer (1985) asserted that ISI should not only facilitate the process of use of data, applications, and other processing technology, but also provide flexibility to meet the future business demands in workstations, processing types, and applications. In merging and acquisition context, ISI is considered as an important success factor when corporations seek to create synergistic effects by integrating two separate business entities in order to increase competitive advantages (Robbins & Stylianou, 1999; Stylianou et al., 1996). In a supply chain context, IT allows “multiple organizations to coordinate their activities in an effort to truly manage supply chain” (Handfield & Nichols, 1999). ISI represents a set of IS practices which supply chain members use to interact with each other. ISI can be both internal focus and external focus (IISI and EISI). Higher level of alignment of ISI practices allows firms to stay competitive in such a rapidly changing environment because firms have to manage different components of technologies by integrating and coordinating them into an efficient, effective, and responsive system (Sikora & Shaw, 1998). With intensification of competition, firms utilize ISI to influence the processes comprising the value chain (Rushton & Oxley, 1994; Williams et al., 1997).

Lambert and Garcia-Dastugue (2006, p.150) point out that “failure to integrate activities effectively will hinder management’s ability to make the entire value system work (Normann and Ramirez 1993).” Integrative relationships can be facilitated by internal logistics improvement, efficient information sharing, and strategic linkages with suppliers and customers. Narasimhan and Kim (2002) examined outcomes of such integration, including performance, on three dimensions: (1) integration across the supply chain, (2) a company’s integration with customers, and (3) a company’s integration with suppliers.

The development of internal supply chain integration should be prior to the external integration with suppliers and customers (Stevens, 1989; Byrne & Markham, 1991; Hewitt, 1994). ISI should happen in a sequential manner from internal integration to external integration. Firms with higher degree of internal ISI are more likely to integrate with its external partners as well because ISI processes development takes time, effort and capital investment. Since firms have already set up internal systems, they have more chance to integrate with other firms which have compatibles systems.
The business environment is changing from competition between firms to between supply chains, IT infra-structural plays a critical role in achieving successful SCI (Vonderembse et al., 2006). In the inter-organizational supply chain context, information technologies allow “multiple organizations to coordinate their activities in an effort to truly manage a supply chain” (Handfield and Nichols, 1999; Rushton and Oxley, 1994; Williams et al., 1997; Rai et al., 2006). Most factors that influence supply chain integration (SCI) are related to information processing issues in data sharing. Information processing theory explains how appropriate technology could help in reaching this goal (Garbraith, 1973; Gavimens et. al., 1999; Rai et al., 2006). Effective information sharing enhances SCI in dynamics external and internal environments (Zhou & Benton, 2007). This study hypothesize that high levels of information integration will enhance cooperation and coordination between a firm and its suppliers and customers. As firms get involved in a highly integrated supply chain, the strategic use of IT is much more expansive in facilitating order fulfillment processes. Customers and suppliers prefer to use information technologies to communicate ordering details and share information with firms. The electronic connection between firms has become a competitive approach to reduce cost and improve services (Bhatt, 2000). Jane et al. (2004) argue that advances in IT have been a primary enabler for firms focusing on inter-organizational business processes. Gangopadday and Hauang (2004) shows that the advances in IT enable information sharing and are key drivers of SCI. Companies have integrated with their customers and suppliers through the utilization of IT. The enhanced capability copes with the sophisticated needs of customers and meets the quality standards of products (Bardi, et al., 1994; Carter & Narasimhan, 1996).

In this study, internal ISI (IISI) is defined by an internal cooperation between business functions. IISI focuses on a full system-visibility of internal supply chain activities including strategic, operational, and infrastructural IS practices. At this stage, all internal functions from raw material management through production, shipping, and sales are connected and integrated real-time. External ISI (EISI) is defined by an external cooperation between a firm and its supply chain partners. We adapt the instruments from Frohlich (2002), Frohlich and Westbrook (2002), Koufteros et al. (2005), Petersen et al. (2005a), and Petersen et al. (2005b) to explore customer integration and supplier integration. Customer integration (CI) is the extent to which purchasers take part in value creating activities and processes. CI includes tailoring internal activities to meet customer needs (Koufteros et al. 2005). Supplier integration (SI) is the extent to which vendors form cooperative relationships by taking part in value creating activities and processes. SI is characterized by a long-term commitment between the collaborators, open communication, and mutual trust. Supplier partnerships involve participants early in the product life cycle; thus ensuring early supplier involvement in product design and access to superior supplier technologies (Narasimhan & Das, 1999; Petersen et al, 2005a, 2005b).

**H1:** Internal IS integration will improve the firm’s operational performance  
**H2:** External IS integration will strengthen the relationship with customer  
**H3:** External IS integration will strengthen the relationship with supplier

**Customer and Supplier Relationship**

In an inter-organizational supply chain context, not only does IT provide a firm with the automation of clerical functions, but IT is also viewed as providing infrastructural and strategic support to the supply chain. Customers and suppliers prefer to use information technologies to communicate ordering details and share information with firms. The electronic inter-connectivity between two or more firms has become essential to reduce cost and improve services (Bhatt, 2000). Jane et al. (2004) argue that advances in IT have been a primary enabler for firms focusing on inter-organizational business processes. Gangopadday and Hauang (2004) show
that the advances in IT make information sharing possible, and these advances are key drivers of supply chain integration.

Through the use of IT, companies have integrated their customers and suppliers, thus enhancing capability to cope with the sophisticated needs of customers and meeting the quality standards of products (Bardi, et al., 1994; Carter & Narasimhan, 1996). Through the utilization of networks, shared databases, and other related information systems, duplicated activities can be eliminated, preventing errors, reducing cycle time in product development, and improving inter-organizational communication.

This study hypothesized that high levels of technology utilization help enhance cooperation and coordination between a firm and its suppliers and customers. Most factors that influenced supply chain integration (SCI) are related to information processing issues that lead to smooth data sharing. Information processing theory explains how appropriate technology could help in reaching this goal (Garbraith 1973; Gavimeni et. al., 1999' Rai et al., 2006). Effective information sharing enhances SCI in dynamics external and internal environments (Zhou & Benton, 2007).

**H4a:** The stronger relationship with customer, the higher the extent of the firm’s operational performance

**H4b:** The stronger relationship with supplier, the higher the extent of the firm’s operational performance

**H5:** The stronger relationship with supplier, the higher the extent of the supplier’s operational performance

**Supply Chain Operational Performance**

Operational performance (OP) indicators measure the effects of CI and SI activities on functional outcomes. The performance of manufacturers can be evaluated by one or more competitive priorities (Hayes & Wheelwright 1984; Christiansen et al. 2003). Taps and Steger-Jensen (2007) examined order winners and manufacturing capabilities such as flexibility, delivery reliability, cost efficiency, and product innovation. Frohlich & Westbrook (2002) studied the effects of the type of web-based demands and supply integration. The benefits of such integration included faster delivery time, reduced transaction costs, greater profitability, and higher inventory turnover. Research indicates that integration is positively related to capabilities such as quality, delivery, flexibility, and/or cost (Khurana & Talbot 1998; Roth 1998; Liu et al., 2012). This study defines OP as the extent to which a firm achieves its operational goals, specifically related to delivery reliability, process flexibility, cost leadership, innovation, and product quality.

When sharing common objectives across the supply chain, firms become more cost effective, efficient, agile, responsive to market and supply chain changes, and more innovative. Highly frequent information exchanges within and between firms in the production processes make the delivery process more stable and reliable. Literature also provides evidence to support that supply chain integration can improve suppliers’ operational activities. Carter and Ellram (1994) find that supplier involvement in product design has positive impacts on defect rate in the later manufacturing stage. The higher the levels of integrated upstream and downstream coordination, the greater the benefits to both buyers and suppliers (Narasimhan and Jayaram, 1998; Johnson, 1999; Frohlich and Westbrook, 2001; and Ahmad and Schroeder, 2001). Supplier integration is especially important in terms of frequent deliveries and reduced buffer inventories (Handheld, 1993). Therefore, many buyers prefer strong upstream connections in their supply chains (Ansari and Modarress, 1990). Other studies have similarly found that strong
supply-side integration improves overall supply chain performance and supports competitive advantage (Akinc, 1993; Tan, Kannan, and Handheld, 1998; Essig and Arnold, 2001). Frequent communication between manufacturing firms and suppliers provides both parties the opportunities to access more efficient manufacturing processes, have higher product quality, implement more reliable logistical systems, reduce production cost, and devote more time on product design and innovation.

Tight integration with customers on the downstream side of a supply chain is equally important to both suppliers and customers. Recent research shows the importance of strong customer integration in the supply chain (Stock, Greis, and Kasarda, 2000; Reeder and Rowell, 2001) because it enhances virtual connections between a buyer and its third-party logistics (Bowersox, Closs, and Stank, 1999; Van Hoek, 2000). Evidence suggests that the stronger the downstream integration, the greater the potential benefits (Clark and Hammond, 1997; Narasimhan and Jayaram, 1998; Lummus, Vokurka, and Alber, 1998; Gilbert and Ballou, 1999). Daugherty et al. (1999) and Waller et al., (1999) linked integrated distribution programs like automatic replenishment to improved performance. Conversely, there are inherent hazards of not fully coordinating activities in the supply chain with downstream partners (Lee and Billington, 1992; Hammel and Kopczak, 1993; Armistead and Mapes, 1993). By extension, this leads to the next two hypotheses.

Supplier performance is an inter-organizational performance measurement dealing with the evaluation of performance outside one’s own organization. The relationship between supplier performance and buyer performance concerns both intra-organizational performance and inter-organizational performance. This study hypothesizes that, in the global supply chain environment, a buyer’s competitive position largely depends on its suppliers’ abilities to respond to the firm’s requirements. Studies have shown that collaboration with suppliers can reduce transaction costs (Dyer, 1997). In giant industries such as automobile and computer, manufacturing firms mostly act as a central coordinator managing other logistic activities over the globe using advanced information technology. For example, Dell Computer manages all the transactions over the Internet, leaving the real operational activities in the hands of the suppliers. With this new way of doing business, supplier performance is crucial for the firm’s survival and competitiveness.

Harley-Davidson has reported that supplier involvement has improved its overall quality, reduced costs, and helped to compete against Japanese manufacturers. Integrated industrial relations between manufacturers and suppliers have also been cited as a crucial factor to the success of Japanese manufacturing firms implementing JIT (Hahn et al., 1983; Waters-Fuller, 1995). Vonderembse and Tracey (1999) empirically tested the relationship between supplier performance and manufacturing performance. The study stated that if supplier performance is highly correlated with manufacturing performance, a firm may be able to meet its manufacturing objectives with regard to production costs, work-in-process inventory levels, product quality, and on-time delivery to the final customers. Thus we suggest that supplier performance is most likely to bring operational benefits to the manufacturing firms; including reduction of inventory, delivery lead-time and supplier cost, and improvement of scheduling flexibility and quality.

Financial Performance

Firm’s financial performance (FP) is the extent to which a firm fulfills its market and financial goals. Wisner (2003) studies the effects of supply chain management strategy on FP by measuring market share, return on assets, overall product quality, overall competitive position, and overall customer service level. Frohlich (2002) used two items to measure e-business performance: annual percent of procurement using the Internet and annual percent of sales/turnover using the Internet. Narasimhan and Kim (2002) used sales growth and market
share growth with a three-year look-back, profitability, return on investment, return on assets, revenue growth, financial liquidity, and net profit to measure FP. Rosenzweig et al. (2003) used four items to measure business performance including pre-tax return on assets, percentage of revenues from new products, overall customer satisfaction, and business unit sales growth. Therefore, FP is a key outcome measure given that a firm’s manufacturing capabilities can be linked to its competitive priorities (Taps and Steger-Jensen 2007). In this study, FP is measured by customer retention rate, sales growth, return on investment (ROI), production throughput time, and overall competitive position.

\[ H6: \] The higher the extent of the firm’s operational performance, the higher the extent of the firm’s performance

\[ H7: \] The higher the extent of the supplier’s operational performance, the higher the extent of the firm’s performance

Table 1 collects the definition for each variable and summaries relevant literature. The conceptual framework used to explore the inter-relationships among CI, SI, BP, and SP is shown in Figure 1.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DEFINITION</th>
<th>REFERENCES</th>
</tr>
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<tbody>
<tr>
<td>Customer Integration (CI)</td>
<td>The extent to which customers takes part in activities and processes that had been in the domain of a firm in a form.</td>
<td>Wikstrom (1996), Koufteros et al. (2005)</td>
</tr>
<tr>
<td>Supplier Integration (SI)</td>
<td>The extent to which supplier take part in activities and processes that had been in the domain of a firm.</td>
<td>Narasimhan &amp; Das (1999), Petersen et al. (2005a), Petersen et al. (2005b)</td>
</tr>
<tr>
<td>Customer Relationship (CR)</td>
<td>The extent to which the manufacturer interacts with its customer</td>
<td>Bardi, et al., 1994; Carter &amp; Narasimhan, 1995</td>
</tr>
<tr>
<td>Supplier Relationship (SR)</td>
<td>The extent to which the manufacturer interacts with its supplier</td>
<td>Rai et al., 2006; Zhou &amp; Benton, 2007</td>
</tr>
</tbody>
</table>
RESEARCH METHODOLOGY

Instrument development for all constructs was carried out in three phases: (1) literature review to identify the domain of the constructs and generate the initial measurement items (Churchill, 1979), (2) review by academic and management experts, and (3) Q-sort (Moore and Benbasat, 1991) using manufacturing managers. The Q-sort results indicate acceptable convergence with the inter-judge raw agreement scores of 91%, overall placement ratio of items 93%, and the Kappa scores of 90%. The final survey items used in this study can be found in Appendix A.

A cross-sectional self-administered mail survey was conducted. A sample was obtained from the Society of Manufacturing Engineers (SME), an internationally known organization of manufacturing managers and engineers. The initial mailing list of 4,000 was randomly selected from the SME members in the East North Central and West North Central regions. 579 surveys did not reach the targeted respondents because of incorrect addresses, 235 responses stated that they would not participate and 14 surveys were returned empty. This left 3,172 in the eligible sample of which 220 surveys were returned providing usable responses. Thus, the response rate for the survey is 6.94% (or 220/3172). A response rate of this size is typical in large-scale surveys that require information from managers (Pflughoeft et al., 2003; Li et al., 2005; Devaraj et al., 2007; Braunscheidel and Suresh, 2009). Respondents were primarily employees holding the title of Manager or Supervisor (80.5%). Of these, 12.3% reported the title of CEO or Director with the balance reporting general management positions consisting of COOs, Chief Manufacturing Engineers, and Vice Presidents, among others. A self-assessment item measured each respondent’s level of computer literacy ranging from 1: know nothing about computers to 10: expert computer user. In an attempt to test for bias between novice and expert computer users, the sample was bifurcated at the mean (µ=7.32) and all of the variables under study were examined using t-tests. None of the variables in the model produced statistically significant results indicating no difference between the novice and expert computer user groups. In terms of industry, 71.81% of respondents represented the rubber and plastic products (SIC 30), fabricated metal products (SIC 34), industrial machinery and equipment (SIC 35), transportation equipment (SIC 37), and other miscellaneous manufacturing industries (SIC 39). Annual sales ranged from $10 to over $100 million for 65% of responding firms, with 24.1% generating > $100 million. Table 2 shows sample characteristics of respondents by job titles, job functions, and level of education.
Non-response bias was tested by comparing results from the first \((n = 148)\) and second \((n = 72)\) mailings. This is a commonly used method for testing non-response bias in Operations Management research (for examples see Narasimhan and Kim, 2001; Tu et al., 2004; Li et al., 2005; Swafford et al., 2006). Chi-square tests were performed on sales volume and t-tests were performed on the summated scale of each construct (Armstrong and Overton, 1977). The results in Table 3 indicate no significant difference in the data between the early and late responders, suggesting that the data is representative of the population.

**Instrument Reliability and Validity Assessment**

Structural Equation Modeling (SEM) was employed to assess the measurement and structural properties of the model (James et al., 1982; Swafford et al., 2006). This analysis was conducted using SPSS and AMOS 18. Content validity was determined through a comprehensive review of the literature, Q-sort, and assessment by a panel of practitioners and academics to ensure that measurement items covered the domain of the construct (Nunnally, 1978; Churchill, 1979). Table 4 displays the original first order instruments, the second order constructs, the standardized item loadings for the measurement models under study (Swafford et al., 2006) as well as the path coefficients between the first and second order models (Braunscheidel and Suresh, 2009). All item loadings are sufficient to demonstrate convergent validity. Items in italic were dropped because of the low factor loading.

<table>
<thead>
<tr>
<th><strong>Table 2:</strong> Sample Characteristics</th>
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</thead>
<tbody>
<tr>
<td><strong>Job Titles</strong> (220)</td>
</tr>
<tr>
<td>CEO/President</td>
</tr>
<tr>
<td>Director</td>
</tr>
<tr>
<td>Manager</td>
</tr>
<tr>
<td>Supervisor</td>
</tr>
<tr>
<td>Engineer</td>
</tr>
<tr>
<td>Other</td>
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Cronbach’s \(\alpha\), composite reliability, and average variance extracted (AVE) were used to test reliability. Convergent validity can be assessed by examining the individual item loadings on their theorized latent variables (Swafford et al., 2006). The Goodness of Fit Index (GFI) indicates the relative amount of variance and covariance jointly explained by the model. The Adjusted Goodness of Fit Index (AGFI) differs from the GFI in adjusting for the number of degrees of freedom (Byrne, 1989). Both range from 0 to 1. Values of 0.9 or more are considered a good fit (Hair et al., 1998). The RMSEA takes into account the error of approximation and is expressed per degree of freedom, thus making the index sensitive to the number of estimated parameters in the model; values less than 0.05 indicate good fit, values as high as 0.08 represent reasonable errors of approximation in the population (Browne & Cudeck, 1993),
values range from 0.08 to 0.10 indicate mediocre fit, and those greater than 0.10 indicate poor fit (MacCallum, Browne, & Sugawara, 1996). A review of Table 5 reveals that almost all constructs display AVE values > 0.50 (both process flexibilities are very close to 0.50), thus providing further evidence of convergent validity. Some items were dropped to improve convergent validity (Note: items in italic were dropped. See Appendix A).

<table>
<thead>
<tr>
<th>Table 3: Test of Non-Response Bias</th>
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<tbody>
<tr>
<td>Variables</td>
</tr>
<tr>
<td>Sales Volume in millions of $ (220)</td>
</tr>
<tr>
<td>&lt;5</td>
</tr>
<tr>
<td>5 to &lt;10</td>
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<tr>
<td>10 to &lt;25</td>
</tr>
<tr>
<td>25 to &lt;50</td>
</tr>
<tr>
<td>50 to &lt;100</td>
</tr>
<tr>
<td>Over 100</td>
</tr>
<tr>
<td>Unidentified</td>
</tr>
<tr>
<td>Variables</td>
</tr>
<tr>
<td>Total score</td>
</tr>
<tr>
<td>IISI</td>
</tr>
<tr>
<td>EISI</td>
</tr>
<tr>
<td>SOP</td>
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<tr>
<td>OP</td>
</tr>
</tbody>
</table>

The calculation formula \( \chi^2 = \sum \left( \frac{f_e - f_o}{f_e} \right)^2 \)

Evidence of discriminant validity exists if the AVE of each construct is greater than the square of the correlations (Braunscheidel and Suresh, 2009). An acceptable alternative suggests that the square root of a construct's AVE should be greater than the correlations between constructs (Chin, 1998; Fornell and Larcker, 1981; Koufteros, 1999; Koufteros et al., 2001). Table 6 displays the correlations between all latent constructs. The square root of the AVE for each construct is bolded and can be found on the diagonal. Each is greater than the value of the correlations in its corresponding row and column.

<table>
<thead>
<tr>
<th>Table 4: Measurement model factor loadings</th>
</tr>
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<tbody>
<tr>
<td>First order construct</td>
</tr>
<tr>
<td>Buyer's Strategic Integration (SI)</td>
</tr>
</tbody>
</table>
9 indicator items
8 indicator items
Buyer’s Operational Integration (OI)
8 indicator items
Buyer’s Network Integration (NI)
Supplier’s Strategic Integration (SI)
9 indicator items
Supplier’s Operational Integration (OI)
8 indicator items
Supplier’s Network Integration (NI)
Buyer’s Cost Leadership
5 indicator items
Buyer’s Innovation
5 indicator items
Buyer’s Product Quality
6 indicator items
Buyer’s Process Flexibility
6 indicator items
Buyer’s Delivery Reliability
6 indicator items
Supplier’s Cost Leadership
5 indicator items
Supplier’s Innovation
5 indicator items
Supplier’s Product Quality
6 indicator items
Supplier’s Process Flexibility
6 indicator items
Supplier’s Delivery Reliability
6 indicator items
Buyer’s Customer Relationship
6 indicator items
Supplier’s Customer Relationship
6 indicator items
Buyer’s Performance (FP)
8 indicator items

Note: All coefficients are statistically significant.

Table 5: Convergent Validity and Reliability Analysis (n = 220)
Finally, it is important to control for common method bias (CMB) prior to evaluating the structural model. CMB can prove problematic in studies that employ survey method from single respondents for data collection by inflating or deflating the relationships among variables (causing both Type I and Type II errors) (Podsakoff et al., 2003). Thus, certain preventive measures were undertaken during the data collection consistent with Rosenzweig (2009). The data were also statistically tested for the presence of CMB following data collection. Harman’s (1967) single-factor test is often used to assess CMB (Rosenzweig, 2009). In this study, the data do not appear to fit the single-factor model, nor does one factor account for a substantial amount of variance. Next, the single-method-factor test advocated by Podsakoff et al. (2003) was employed. After controlling for the effects of the latent method factor, all of the path loadings of the hypothesized items remained statistically significant on their target constructs and the average item variance explained by the substantive constructs was substantially greater than those linked to the latent method factor. Further, only a few of the latent method factor coefficients were statistically significant. Thus, the presence of CMB is unlikely (Podsakoff et al., 2003; Rosenzweig, 2009).

<table>
<thead>
<tr>
<th>Buyer’s Operational Performance</th>
<th> </th>
<th>min ≥ 0.70</th>
<th>≥ min 0.50</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery Reliability (4)</td>
<td>.88</td>
<td>.89</td>
<td>.66</td>
<td>1.00</td>
</tr>
<tr>
<td>Process Flexibility (6)</td>
<td>.83</td>
<td>.82</td>
<td>.45</td>
<td>.98</td>
</tr>
<tr>
<td>Cost Leadership (5)</td>
<td>.87</td>
<td>.60</td>
<td>.60</td>
<td>.98</td>
</tr>
<tr>
<td>Innovation (4)</td>
<td>.79</td>
<td>.80</td>
<td>.50</td>
<td>.98</td>
</tr>
<tr>
<td>Product Quality (4)</td>
<td>.86</td>
<td>.86</td>
<td>.61</td>
<td>.98</td>
</tr>
<tr>
<td>Buyer’s IS Integration</td>
<td>.92</td>
<td></td>
<td>.85</td>
<td>.81</td>
</tr>
<tr>
<td>SI (5)</td>
<td>.91</td>
<td>.89</td>
<td>.62</td>
<td>.98</td>
</tr>
<tr>
<td>OI (6)</td>
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<td>NI (8)</td>
<td>.89</td>
<td>.88</td>
<td>.52</td>
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<tr>
<td>Buyer’s Customer Relationship</td>
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<td>Buyer’s Performance</td>
<td>.84</td>
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<td>.99</td>
<td>.96</td>
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<tr>
<td>Supplier’s Operational Performance</td>
<td>.93</td>
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<td>.86</td>
<td>.83</td>
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<tr>
<td>Delivery Reliability (5)</td>
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<td>.98</td>
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<tr>
<td>Process Flexibility (5)</td>
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<td>.99</td>
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<td>Cost Leadership (5)</td>
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<td>.97</td>
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<td>Product Quality (4)</td>
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<td>.86</td>
<td>.61</td>
<td>1.00</td>
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<tr>
<td>Supplier’s IS Integration</td>
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<td>.83</td>
<td>.79</td>
</tr>
<tr>
<td>SI (6)</td>
<td>.95</td>
<td>.93</td>
<td>.72</td>
<td>.98</td>
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<tr>
<td>OI (6)</td>
<td>.91</td>
<td>.91</td>
<td>.64</td>
<td>.98</td>
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<tr>
<td>NI (6)</td>
<td>.90</td>
<td>.90</td>
<td>.60</td>
<td>.97</td>
</tr>
<tr>
<td>Supplier’s Customer Relationship</td>
<td>.88</td>
<td></td>
<td>.97</td>
<td>.93</td>
</tr>
</tbody>
</table>

Table 6: Discriminant validity (square root of AVE on diagonal in bold)
The results from the assessment of the structural models appear in Tables 7 corresponding to Hypotheses 1 to 7. Table 7 indicates that Hypothesis 1 is supported at the \( p<0.05 \) level (\( \beta=0.513, t=2.453 \)), which suggests that the firm's level of IS integration influences its operational performance. Hypothesis 2 is supported, which lends support that the level of IS integration with suppliers may improve customer relationship with the firm.

**DISCUSSION AND CONCLUSIONS**

H4 and H5 are one-way relationship because, currently, most manufacturing industries are demand driven. A good relationship with customer will have more significant impact than the reverse influence. Therefore, we can see good relationship with supplier won't help the manufacturing firms as buyers (H4b), but it will help the supplier very much because the manufacturing firms are suppliers' customer. It is also worth to mention that our research shows that the improved suppliers' operational performance will not benefit the manufacturing firms' financial performance. Because we are focusing on de4mand-driven manufacturing firms, their suppliers are more stable and mature. The uncertainty from downstream customers dominates the impacts of supply chain partners on the manufacturers' financial performance.

**REFERENCES**


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Gu, Jitpaiboon

Enhancing Financial Performance with Information Integration


Gu, Jitpaiboon

Enhancing Financial Performance with Information Integration

*Management, 37*, 43–49.


Appendix A. Measurement of research constructs (Items in italic were dropped to improve divergent validity in the final model.)

IT Use: The following situations describe the extent to which the **buying firm (or supplier) uses information technology (IT) for strategic (planning), operational, and infrastructural purposes**. Please circle the appropriate number to indicate the extent to which you agree or disagree with each statement as applicable to your unit.

<table>
<thead>
<tr>
<th>Coding</th>
<th>Items</th>
<th>Coding</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>SII1</td>
<td>Formulate long-term collaborative decision making.</td>
<td>SIE1</td>
<td>Formulate long-term collaborative decision making.</td>
</tr>
<tr>
<td>SII2</td>
<td>Justify long-term business plans.</td>
<td>SIE2</td>
<td>Justify long-term business plans.</td>
</tr>
<tr>
<td>SII3</td>
<td>Analyze long-term business plans.</td>
<td>SIE3</td>
<td>Analyze long-term business plans.</td>
</tr>
<tr>
<td>SII4</td>
<td>Develop long-term business opportunities.</td>
<td>SIE4</td>
<td>Develop long-term business opportunities.</td>
</tr>
<tr>
<td>SII5</td>
<td>Identify new markets.</td>
<td>SIE5</td>
<td>Identify new markets.</td>
</tr>
<tr>
<td>SII6</td>
<td>Identify long-term technology justification and planning.</td>
<td>SIE6</td>
<td>Identify long-term technology justification and planning.</td>
</tr>
<tr>
<td>SII7</td>
<td>Study strategies of competitors.</td>
<td>SIE7</td>
<td>Study strategies of competitors.</td>
</tr>
<tr>
<td>SII8</td>
<td>Define long-term competitive positioning.</td>
<td>SIE8</td>
<td>Define long-term competitive positioning.</td>
</tr>
<tr>
<td>SII9</td>
<td>Set long-term strategic goals.</td>
<td>SIE9</td>
<td>Set long-term strategic goals.</td>
</tr>
</tbody>
</table>
### Adjust daily manufacturing processes.

**OII1** Adjust daily manufacturing processes.

**OIE1** Adjust daily manufacturing processes.

### Adjust daily product development processes.

**OII2** Adjust daily product development processes.

**OIE2** Adjust daily product development processes.

### Control daily product quality.

**OII3** Control daily product quality.

**OIE3** Control daily product quality.

### Manage daily order quality.

**OII4** Manage daily order quality.

**OIE4** Manage daily order quality.

### Exchange daily inventory information.

**OII5** Exchange daily inventory information.

**OIE5** Exchange daily inventory information.

### Select suppliers.

**OII6** Select suppliers.

**OIE6** Select raw materials and parts.

### Manage daily logistical activities.

**OII7** Manage daily logistical activities.

**OIE7** Manage daily logistical activities.

### Establish daily product forecasts.

**OII8** Establish daily product forecasts.

**OIE8** Establish daily product forecasts.

<table>
<thead>
<tr>
<th>Firm’s Infrastructural IT Use</th>
<th>Supplier’s Infrastructural IT Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data Integration</strong></td>
<td><strong>Data Integration</strong></td>
</tr>
<tr>
<td><strong>DII1</strong> Use standard data definitions and codes.</td>
<td><strong>DIE1</strong> Use standard data definitions and codes.</td>
</tr>
<tr>
<td><strong>DII2</strong> Use standard information/data format.</td>
<td><strong>DIE2</strong> Use standard information/data format.</td>
</tr>
<tr>
<td><strong>DII3</strong> Use standard presentation format.</td>
<td><strong>DIE3</strong> Use standard presentation format.</td>
</tr>
<tr>
<td><strong>DII4</strong> Use centralized databases.</td>
<td><strong>DIE4</strong> Use centralized databases.</td>
</tr>
<tr>
<td><strong>DII5</strong> Use database synchronization system.</td>
<td><strong>DIE5</strong> Use database synchronization system.</td>
</tr>
<tr>
<td><strong>DII6</strong> Integrate data and information.</td>
<td><strong>DIE6</strong> Use compatible database systems.</td>
</tr>
<tr>
<td><strong>Network Integration</strong></td>
<td><strong>Network Integration</strong></td>
</tr>
<tr>
<td><strong>NII1</strong> Use IS networks to communicate with other departments.</td>
<td><strong>NIE1</strong> Use IS networks to communicate with other.</td>
</tr>
<tr>
<td><strong>NII2</strong> Use IS networks to connect to each other’s database.</td>
<td><strong>NIE2</strong> Use IS networks to connect to each other’s database.</td>
</tr>
<tr>
<td><strong>NII3</strong> Use IS network applications.</td>
<td><strong>NIE3</strong> Use IS network applications.</td>
</tr>
<tr>
<td><strong>NII4</strong> Use IS networks to share information with other departments.</td>
<td><strong>NIE4</strong> Use IS networks to share information with each other.</td>
</tr>
<tr>
<td><strong>NII5</strong> Use IS networks to connect to centralized databases.</td>
<td><strong>NIE5</strong> Use IS networks to facilitate periodic meetings.</td>
</tr>
<tr>
<td><strong>NII6</strong> Use IS networks to facilitate periodic interdepartmental meetings.</td>
<td><strong>NIE6</strong> Use compatible network architectures.</td>
</tr>
<tr>
<td><strong>NII7</strong> Use compatible network architectures.</td>
<td></td>
</tr>
</tbody>
</table>