SUPPLIER INTEGRATION – ALWAYS A GOOD THING OR DEPENDS …

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ABSTRACT

Previous studies have shown that integration has positive impacts on various aspects of performance. However, the question as to whether supplier integration is always beneficial remains unanswered. This study explores the issue of supplier integration in the context of product complexity (PC). This study thus examines the impact of supplier operational integration (SOI) and supplier relational integration (SRI) on supply chain efficiency and firm performance under conditions of product complexity. Supplier integration is proposed to be more beneficial when the product in question is more complex. Proposed research model is tested using survey data from US manufacturing firms. Implications for theory and practice are presented.

INTRODUCTION

Supplier integration is generally seen as a way to improve activities ranging from product development [20] [31] and going all the way to logistics and distribution [43]. Despite all the attention that the concept of integration has received in the recent past, the fact remains that integration is not easy to achieve. Achieving integration at the intra-firm level itself is quite challenging. Now achieving that at the inter-firm level is definitely exponentially more challenging. Also, achieving integration calls for substantial investment of resources for all parties involved. In such a case, it makes sense to understand the nature of conditions under which integration is more/less beneficial. Anecdotal evidence also suggests that the push for integration between firms and their suppliers has increased over time. Apart from that, another noticeable change is with respect to the complexity of the products that are being manufactured. We have noticed that the level of complexity of these products has increased over time. In the quest to manage the effects of increasing levels of product complexity in the supply chain, companies have explored various avenues. One of them being, integrating suppliers across the supply chain. This kind of integration is said to increase the ability of the supply chain to achieve coordination in the face of complexity. However, since supplier integration requires time, effort and commitment of resources, it would be worthwhile to understand the conditions under which integration makes more sense. In particular, this paper considers conditions of product complexity. This paper thus addresses the following research questions: (1) What is the effect of supplier integration on supply chain efficiency? and (2) Is the impact of supplier integration on supply chain efficiency different under different conditions of product complexity?

To address the above mentioned research questions, the research model outlines (1) a direct relationship between supplier operational integration / supplier relational integration and supply chain efficiency and (2) a moderating effect of product complexity on the relationship proposed in (1). Data from a survey of US manufacturing firms is used to test the proposed relationships. The results of the study suggest a positive relationship between supplier integration and supply chain efficiency. However, the results do not support the moderating effect of product complexity. Implications of these results are discussed.

THEORY AND HYPOTHESES DEVELOPMENT

Dimensions of Supplier Integration

In the context of supplier integration, a distinction can be made based on the level and the primary intent of integration [36]. At one end, researchers have looked at supplier integration from a purely operational perspective where the focus is on coordination of day-to-day activities and management of material movements, ordering processes and numerous other short term transactions [32]. On the other hand, studies have also addressed the strategic nature of supplier integration activities. The focus in that case is more long term, and collaborative in nature. It calls for building relationships between supply chain partners, sharing information and designing collaborative processes [29]. Based on this distinction, this study explores the issue of supplier integration by looking at it in terms of Supplier Operational Integration (SOI) and Supplier Relational Integration (SRI). *Supplier Operational Integration is defined as the extent to which the focal firm collaborates with its suppliers to manage day-to-day transactions or short-term activities*. On the other hand, *Supplier Relational Integration is defined as the extent to which the focal firm collaborates with its suppliers to manage long term and strategic activities.*

This study proposes three key elements of integration – Information sharing, Decision synchronization and Collective learning. Information sharing is seen as a key element of integration, be it at an operational level or at a strategic level [36] [32] [29]. It creates visibility and reduces uncertainty [25]. *At the operational level, Information sharing is seen as the extent to which a focal firm and its suppliers exchange transactional information. At the relational level, Information sharing is seen as the extent to which a focal firm and its suppliers exchange strategic information*. The second element of integration is proposed to be Decision synchronization. Synchronizing decisions between supply chain partners helps balance supply and demand. Lack of synchronization would result in a supply chain with either excess inventory or stock outs. Synchronization generally involves getting together and making joint decisions that are aimed at reaching the identified objectives. *At the operational level, Decision synchronization is defined as the extent to which the firm makes joint decisions for day-to-day interface activities with its suppliers*. *At the relational level, Decision synchronization is defined as the extent to which the firm makes joint decisions concerning strategic planning activities with its suppliers.* Collective learning is proposed to be the third element of supplier integration. The ability to learn from a partner in order to improve operations is key to the success of any partnership. Collective learning enables the creation of shared procedures and processes in the context of integration [24]. *Collective learning at the operational level is thus defined as the extent to which the firm and its suppliers jointly develop knowledge and competencies to manage day-to-day activities. At the relational level, Collective learning is defined as the extent to which the firm and its suppliers jointly develop knowledge and competencies to manage long term strategic activities*.

Supply Chain Efficiency and Firm Performance

Efficiency in general refers to “doing things right”. Efficient supply chains are the ones that can minimize cost and inventory build-up throughout the chain [7]. Efficient supply chains are also known to reduce lead times and minimize variability throughout the system [41] [26]. In this study, *Supply*

chain efficiency refers to the extent to which the supply chain optimizes cost, inventory and delivery performance.

Firm performance can be assessed from an operational perspective and from a market perspective (e.g. [14] [37] [16] [3]. The operational perspective delves into whether the firm is performing well in terms of cost, quality, delivery reliability and flexibility. The market perspective looks at market indicators such as revenue growth, market share etc. Ultimately the determinant of a firm's performance is its ability to achieve competitive advantage by creating a defensible position over competitors [27]. This study thus defines *Firm Performance as the extent to which the firm meets its competitive goals*.

Product Complexity

A complex system in general is "one made up of a large number of parts that interact in a non-simple way'' [33]. This definition identifies two things – numerousness and interactions. Numerousness has also been addressed in terms of multiplicity in the context of product complexity. Both numerousness and multiplicity in this case refer to the number of components that make up the product system or the number of sub-systems that make up a product [30]. Interaction in this context refers to the extent to which the various sub-systems are interconnected. In a complex product, the close interaction between the various sub-systems means that a change in one part of the system will necessitate changes in other parts of the systems as well [17]. Another aspect of product complexity is the novelty of the product. Product novelty refers to the newness of the product and/or its associated product architecture [38] [13]. It takes time for manufacturers to understand the complex interactions associated with a new product and managing a new product is considerably more challenging [18]. Technology intricacy which refers to the complexity of the core technology is another important component of product complexity. As with product novelty, technology intricacy creates initial challenges and challenges continue while various aspects of the technology unravel over time [34]. *Product Complexity is thus defined as a state of difficulty that is a function of component multiplicity, component interactions, product novelty and technology intricacy.*

Linking Supplier Integration, Supply Chain Efficiency and Firm Performance

Information sharing is the foundation for integration between supply chain partners. It ensures that actors across the chain are on the same page by ensuring demand visibility which is extremely critical for balancing supply and demand [26]. Sharing operational information such as actual customer demand, inventory levels, delivery schedules etc. reduces uncertainty and improves efficiency of overall operations [25]. While operational information sharing is much more prevalent in supply chains, sharing of strategic information is not as widely observed. However, research has shown that sharing information that is strategic in nature can be extremely beneficial. For instance, sharing long term plans for products/customers, technology trends and forecasts ensure that suppliers are adequately geared up and prepared for things to come in the future. Studies have shown that sharing strategic information can reduce inventory cost and increase fill rate [26].

Decision synchronization by means of joint decision making is a key component of supplier integration and these decisions can be operational or strategic in nature. At the operational level, manufacturers and

their suppliers frequently make joint decisions regarding inventory levels, production schedules, delivery schedules etc. This is said to improve efficiency by reducing overall cost and inventory levels throughout the supply chain [28]. At the strategic level, firms and suppliers make joint decisions to design their supply network. For instance, facility location is one such long term decision that provides efficiency benefits for years to come [2]. Other long term joint decisions that contribute to improved efficiency include things such as technology selection, capacity planning etc.

Collective learning delves into joint learning and development of competencies. Joint learning activities are said to improve efficiency by reducing time, effort and money that goes into various activities [40] [15] [35]. As evidenced in the automotive industry, collective learning with suppliers helps improve operational efficiencies by streamlining production processes, reducing defect rate and improving material flows. In the context of product development, strategic learning arrangements between partners lead to development of improved products, shorter lead times and shorter time-to-market [31].

Thus, this study proposes:

H1a: Supplier Operational Integration is positively related to Supply Chain Efficiency.

H1b: Supplier Relational Integration is positively related to Supply Chain Efficiency.

Firms today realize that they have look beyond their organizational boundaries in order to improve their firm performance. Firms like Walmart exert control over multiple echelons of their supply chain for this reason. In most manufacturing firms, over sixty percent of their cost is from the purchase of raw materials and components that go into the production process. Every dollar saved in the procurement process adds to the bottom line of the firm. As a result, a firm's success largely depends on its ability to keep supply chain costs low, reduce lead time throughout the supply chain and achieve reliable deliveries. Thus, this study proposes:

H2: Supply Chain Efficiency is positively related to Firm Performance.

Moderating role of Product Complexity

According to Contingency theory, a method or approach may not necessarily be the ideal option under all instances. This suggests that firms should choose their approach by considering appropriate situational variables. Along the same lines, this study proposes examining the benefits of supplier integration under conditions of product complexity. Anecdotal evidence suggests that the need for integration and benefits of integration increase as the system becomes more complex. This can be explained using Information processing theory. According to this theory, information processing requirements increase with an increase in uncertainty and task complexity [10]. Under such conditions, inability to effective process information will adversely affect performance. One of the ways to deal with this would be to increase information processing capability by designing programs or by formulating rules to achieve coordination [10]. Supplier integration is proposed to be one such arrangement. The performance benefits of supplier integration are proposed to be greater under conditions of high product complexity. Under conditions of low product complexity, the costs of integration may not be adequately offset by the benefits of integration. Also, when product complexity is

low, firms might be able to achieve adequate levels of coordination through their existing mechanisms (eg: contracts) and not go through the hassle of integrating with suppliers. Thus:

H3a: Product complexity moderates the relationship between Supplier operational integration and Supply chain efficiency.

H3b: Product complexity moderates the relationship between Supplier relational integration and Supply chain efficiency.

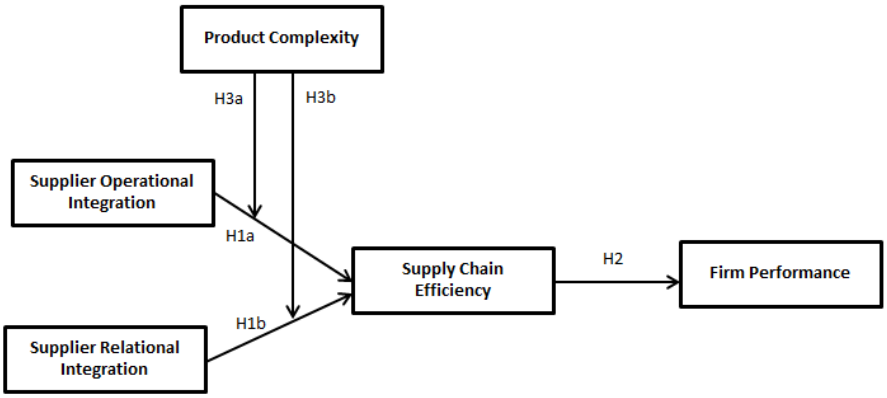

Figure 1: Conceptual Model

METHODOLOGY

Measures and Questionnaire Design

The measures for the two supplier integration constructs and product complexity were developed; while the measures for supply chain efficiency and firm performance were adopted from previous studies. The measurement items were identified through literature review and tested for content validity by consulting with academic experts and industry professionals. The measurement instruments were then pilot tested using Q-sort methodology and were further refined by modifying and/or deleting items based on the feedback of participants. An online questionnaire was designed with the indicators being measured on a five-point likert scale (1 = strongly disagree and 5 = strongly agree).

Sampling and Data Collection

Data was collected from manufacturing companies in USA. To obtain a representative sample, prospective respondents were randomly selected from the Lexis Nexis Academic database. Prospective respondents included professionals in managerial roles in the areas of purchasing, supply chain, manufacturing and operations. The sample was refined based on NAICS codes (31 to 33) and company size. 270 complete responses were received. The measures were then tested for reliability, convergent validity and discriminant validity. Reliability was evaluated using Cronbach's alpha scores. Confirmatory factor analysis (CFA) was used to test for convergent validity. Discriminant validity was assessed by evaluating the correlation coefficients of constructs [11]. Accordingly, pair-wise comparison of the correlation coefficients to the square root of the average variance extracted (AVE) was conducted.

The square root of AVE estimate was found to be greater than the correlation coefficient, which indicates discriminant validity [9] [19] [22].

EMPIRICAL RESULTS

The proposed relationships were tested using AMOS package for Structural Equation Modeling (SEM). The overall model fit of the proposed model was assessed by the following model fit indices – Goodness of Fit (GFI), Adjusted Goodness of Fit (AGFI), Root Mean Square Residual (RMR), Normed Fit Index (NFI) and Comparative Fit Index (CFI). Individual relationships were then examined.

Table 1: Hypotheses Testing Results

Hypothesis	Regression Coefficient	t-value	Supported or Not Supported
H 1a	0.17	2.2**	Supported
H 1b	0.23	3.0***	Supported
H 2	0.27	9.1***	Supported
H 3a	0.05	0.71	Not Supported
H 3b	-0.02	-0.33	Not Supported
GFI = 0.97; AGFI = 0.93; CFI = 0.98; RMR = 0.02; RMSEA = 0.08 *** = p<0.01; **= p<0.05; *= p<0.1			

DISCUSSION AND CONCLUSION

Based on Contingency theory, this study suggests that supplier integration may not be the solution under all circumstances and thus examines the impact of supplier integration on performance when the product in question is complex in nature. The lack of support for the moderating relationship perhaps indicates that there are other factors that drive the need for close integration between a firm and its suppliers. Changing dynamics within the supply chain caused by factors such as an increase in number of suppliers, geographic spread of the supply base, operational diversity within the supply base perhaps create the need for close integration between supply chain partners. However, product complexity may in fact have an effect on the structure and nature of the supply base itself. Thus the lack of support for the moderating effect creates the need to examine other factors that may have a significant role to play.

In terms of managerial implications, this study indicates that firms have to look beyond information sharing if they intend to achieve high levels of supplier integration. It identifies the importance of decision synchronization and joint decision making. The study also indicates that performance benefits can be derived from engaging in collaborative learning with supply chain partners. The study contributes to theory by examining supplier integration in terms of three key components. It identifies measures for each of these components of supplier integration and also develops measures for product complexity which build on the work of previous studies. The study also adds to the development and application of Information processing view and Contingency view to the context of product complexity and supplier integration. The study is limited by the fact that the data collected was cross-sectional in nature and limited to the manufacturing. Future studies could consider these limitations and consider broadening the scope and applicability of the ideas suggested in this study.

References available upon request