The Impact of Information Technology and Partner Relationship on Supply Chain Performance

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Abstract: This study provides a framework to understand the relationships between IT enablers, partner relationship, and supply chain performance. Data for this study was collected from 196 organizations and the relationships proposed in the framework were tested using structural equation modeling. The results indicate that higher levels of IT usage directly lead to better partner relationship, which in turn leads to higher levels of supply chain performance. The results also show that IT enablers do not have a direct impact on supply chain performance. IT impacts supply chain performance indirectly through enabling good relationship with supply chain partners. The implications of the research were discussed at the end.

Keywords: Information Technology, Partner Relationship, Supply Chain Performance

I. Introduction

As competition in the 1990s intensified and markets became global, so did the challenges associated with getting a product and service to the right place at the right time at the lowest cost. Organizations began to realize that it is not enough to improve efficiencies within an organization, but their whole supply chain has to be made competitive. The understanding and practicing of Supply Chain Management (SCM) has become an essential prerequisite to staying in the competitive global race and to growing profitably [5] [24].

The purpose of this study is to explore the relationships between IT enablers, partner relationship, and supply chain performance. The measurements for the three constructs are adopted from previous literature [12]. Structural equation modeling is then used to test the hypothesized relationships. Results indicate that higher levels of IT enablers lead to better partner relationship, which in turn leads to higher supply chain performance.

The reminder of this paper is organized as follows. The next section presents the research framework, provides definitions and theory underlying each dimension of IT enablers and partner relationship, and discusses the concept of supply chain performance and develops the hypothesized relationships. The research methodology and analysis of results are then presented, followed by the conclusion from this study and implication for practitioners.

II. Research Framework

Figure 1 presents the research framework. The framework proposes that IT enablers have a direct impact on partner relationship that in turn has a direct impact on supply chain performance. It is also proposed that IT enablers will directly impact supply chain performance. IT enablers include communication tools, resource planning tools and supply chain management tools. Partner relationship are identified as including trust in trading partners, commitment of trading partners, and shared vision between trading partners. Supply chain performance is measured by supply chain flexibility, supply chain integration, customer responsiveness, supplier performance, and partnership quality. The following section will discuss briefly each construct and develop hypotheses linking those constructs.

IT Enablers
By reviewing relevant literature [6] [7] [9], fourteen IT tools are identified. These IT tools are further divided into three groups in terms of their primary purpose: 1) Communication Tools, 2) Resource Planning Tools, and 3) Supply Chain Management Tools. *Communication Tools* refer to the IT used to facilitate data transfer and communication between trading partners, which include Electronic Data Interchange
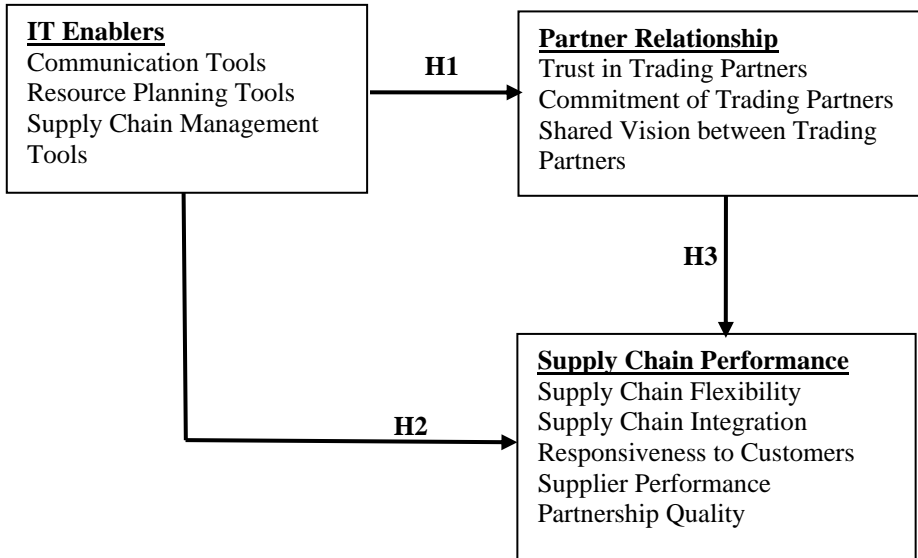
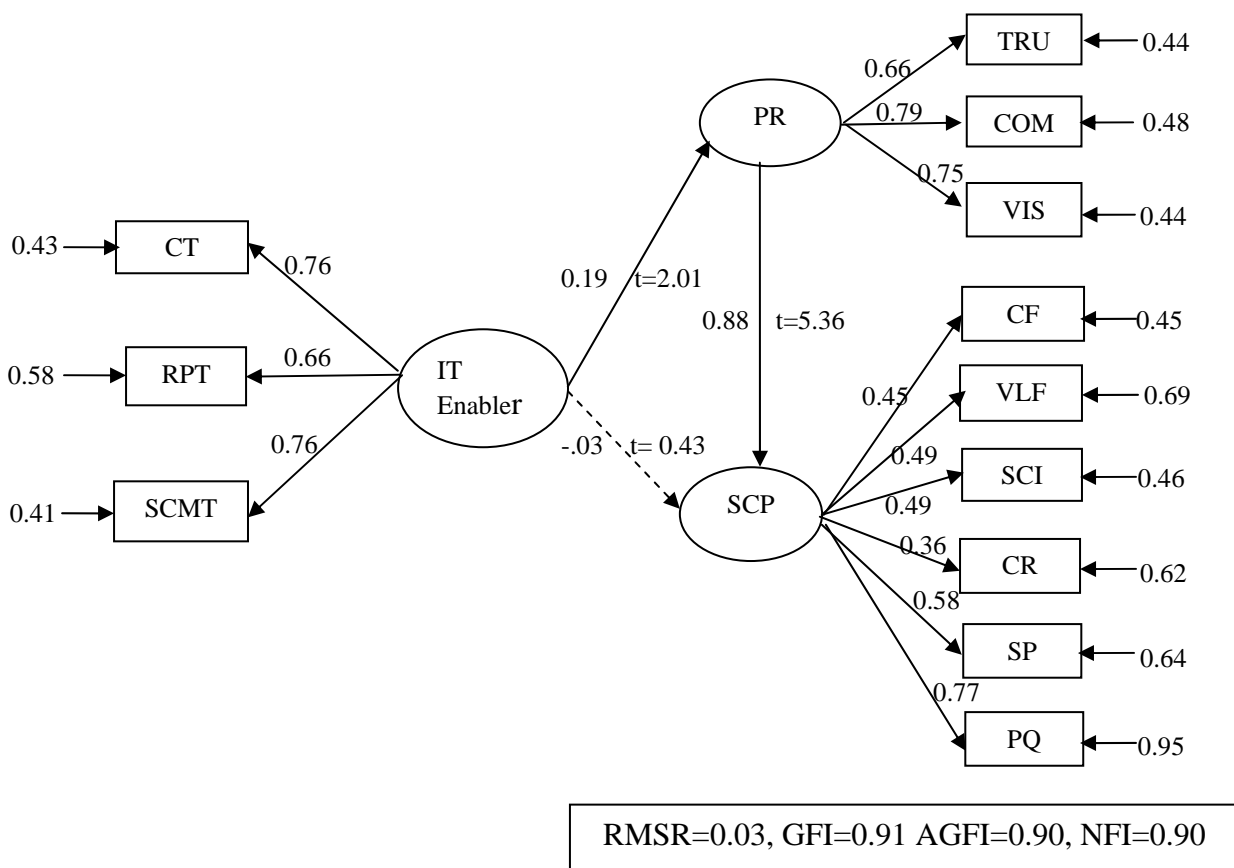**Figure1. Research Framework**

Figure 2. Structural Model of IT enablers, Partner Relationship, and Supply Chain
Performance

(EDI), Electronic Fund Transfer (EFT), Internet, Intranet, and Extranet; *Resource Planning Tools* refer to the IT used to integrate the resource planning processes in an organization, which include Material Requirement Planning (MRP), Manufacturing Resources Planning (MRPII) and Enterprise Resource Planning (ERP). *Supply Chain Management Tools* are identified as the IT used to manage the various processes and relationships in the entire supply chain, which include Distribution Requirement Planning (DRP), Customer Relationship Management (CRM), Supplier Relationship Management (SRM), Vendor Managed Inventory (VMI), Data Warehouse (DW), and SCM software.

Partner Relationship

Partner relationship refers to the degree of trust, commitment, and shared vision between trading partners. IT can be used to easily link physical supply chain processes, but not partner relationships. We consider partner relationship conducive to SCM as including three sub-dimensions: trust in trading partners, commitment of trading partners, and shared vision between trading partners. *Trust in Trading Partners* is defined as the willingness to rely on a trading partner in whom one has confidence [15] [21]. *Commitment of Trading Partners* refers to the willingness of buyers and suppliers to exert effort on behalf of the relationship [15] [21. *Shared Vision between Trading Partners* is defined as the degree of similarity of the pattern of shared values and beliefs between trading partners [11].

Supply Chain Performance

Li [12] develop and validate a set of five measurements for supply chain performance including supply chain flexibility, supply chain integration, customer responsiveness, supplier performance and partnership quality. *Supply Chain Flexibility* refers to those flexibilities that directly impact an organization's customers (i.e. flexibilities that add value in the customer's eyes) and are the shared responsibility of two or more functions along the supply chain, whether internal (e.g., marketing, manufacturing) or external (e. g. suppliers, channel members) to the organization [26]. *Supply Chain Integration* is defined as the extent of all activities within a firm, and the activities that integrated together its suppliers, customers, and other supply chain members [18]. *Customer Responsiveness* is defined as the speed of a firm's response to its customers' requests [1] [18]. The performance of SCM must ultimately be measured by its responsiveness to customers [10]. *Supplier Performance* is defined as suppliers' consistency in delivering materials, components or products to a firm on time and in good condition [1] [4] [24]. *Partnership Quality* may be expressed as how well the outcome of a partnership delivered matched the participants' expectation [11].

Research Hypotheses

The SCM framework developed in this study proposes that IT enablers have a direct impact on partner relationship. For example, IT enables timely and accurate information sharing between trading partners, thus facilitating the establishment of good partner relationships. The usage of EDI contributes to partnership satisfaction, success, and longevity [27], which are true indicators of trust and commitment. Moreover, extranet can be used to communicate a shared vision of SCM to one's supply chain partners. Based on the above it is hypothesized that:

Hypothesis 1: The higher the usage of IT enablers, the higher the level of partner relationship.

IT enablers impact not only partner relationship, but also the supply chain performance [8] [21]. For example, the usage of EDI can support secured information sharing between trading partners [13] [23]. Skipper and Hanna [20] and Swafford et al. [22] found that the use of IT enablers lead to increased supply chain flexibility. In addition, Information sharing enabled by IT also creates opportunities for increased supply chain agility/integration [22]. Li et al. [14] found that the implementation of IT lead to supply chain integration that in turn lead to enhanced supply chain performance. It is hypothesized that:

Hypothesis 2: The higher the usage of IT enablers, the higher the level of supply chain performance

The problems in the supply chain, in most cases, are not technology issues, but are people issues. No amount of expensive software can compensate for flawed human thinking or for corporate cultures that create antagonistic relationships within a supply chain [3]. Boddy et al. [2] explore empirically partnership between suppliers and customers through an interaction model and find that lack of shared vision (such as the cultural and other differences between the parties) causes difficulty in cooperation at first. Actions are then taken to improve cooperative behaviors that support further co-operation between the organizations. The empirical result of Nyage at al. [16] indicated that trust and commitment lead to improved supply chain performance and satisfaction with supply chain relationship. Panayides and Lun [17] found that trust lead to innovativeness and higher performance in the supply chain. The above arguments lead to:

Hypothesis 3: The higher the level of partner relationship, the higher the level of supply chain performance.

III. Research Methodology

Empirical data for testing the research framework was collected via a field survey. Three constructs were measured in this study: IT enables, partnership relationships and supply chain performance. All construct were developed and tested using four phases: (1) item generation, (2) pre-pilot study, (3) pilot study, and (4) large-scale data analysis. The items for each construct were generated through a comprehensive literature review. In the pre-pilot study, these items were reviewed by six academicians and re-evaluated through structured interviews with three practitioners who were asked to comment on the appropriateness of the research constructs. Based on the feedback from the academicians and practitioners, redundant and ambiguous items were either modified or eliminated. New items were added wherever deemed necessary. In the pilot study stage, the three round Q-sort method was used to pre-assess the convergent and discriminant validity of the scales.

Large-scale Data Analysis

Mailing lists were obtained from two sources: the Society of Manufacturing Engineers (SME) and the attendees at the Council of Logistics Management (CLM) conference in New Orleans, 2000. The final version of the questionnaire was administrated to 3137 target respondents. The survey was sent in three waves. There were 196 complete and usable responses, representing a response rate of approximately 6.3%.

Among the respondents, almost 20% of the respondents are CEO/President/Vice President Director. About half of the respondents are managers, some identified them as supply chain manager, plant manager, logistics manager or IT manager in the questionnaire. The areas of expertise were 30% purchasing, 47% manufacturing production, and 30% distribution/transportation/sales. It can be seen that respondents have covered all the functions across a supply chain from purchasing, to manufacturing, to distribution and transportation, and to sales. Moreover, about 30% of the respondents are responsible for more than one job function, and they are expected to have a broad view of SCM practice in their organization.

Based on 196 responses, all construct were validated with the following objectives in mind: purification, unidimensionality, reliability, convergent and discriminant validity. After the validation, supply chain flexibility is split into two constructs: customization flexibility, and volume and launch flexibility. The final list of items for each construct is listed in Appendix A.

IV. Results for the Structural Model

The theoretical framework illustrated in Figure 1 has three hypothesized relationships among the variables IT enablers, Partner Relationship, and Supply Chain Performance. Figure 2 displays the path diagram resulting from the structural modeling analysis using LISREL. The results exhibit that all the measurements have significant loadings to their corresponding second-order construct. Overall, the model has an excellent fit with GFI=0.91, AGFI=0.90, and NFI=0.90. The RMSR is only 0.03, which is very good.

The results support hypothesis 1, which claims that the usage of IT enablers will have a positive impact on partner relationship. The standardized coefficient is 0.19 which is statistically significant at .05 (t =2.10). The statistical significance of Hypothesis 1 confirms that usage of various information technologies, such as EDI, Internet, intranet, extranet, ERP, CRM, and DW, will facilitate the establishment of good relationships between supply chain partners, characterized by high levels of trust, commitment, and shared vision.

The results also indicate that high levels of partner relationships lead to high levels of supply chain performance, Hypothesis 3. The standardized coefficient is 0.88 which is statistically significant at .05 (t =5.36). This result confirms the critical role of partner relationship in improving supply chain performance. As already pointed out in the literature, the biggest challenge for managing supply chain is people issues, not technology issues since no amount of expensive software can compensate for flawed human thinking. A good partner relationship built on trust, commitment and shared vision is important for building a flexible and lean supply chain.

Hypothesis 2 is not supported which indicates that usage of IT enablers does not have a direct impact on supply chain performance. The standardized coefficient is -0.03 with a t value of 0.43. Combining Hypothesis 1, 2, and 3, it can be concluded that the impact of IT enablers on supply chain performance is indirect, through partnership relationship. This is an interesting finding. Previous researches have reported that the direct impact of IT on improving supply chain performance. However the results of this study suggest an indirect impact of IT.

It can be seen that hypothesis 3 (the impact of partnership relationship on supply chain performance) has much higher standardized coefficient (.88) than that of hypothesis 1 (the impact IT enablers on partnership relationship). This indicates that partnership relationship has much stronger impact on supply chain performance.

V. Conclusions, Implications and Future Research

This paper provides theoretical justification for a framework that describes the relationships between IT enablers, partner relationship, and supply chain performance. The results indicate that higher levels of IT usage directly lead to better partner relationship which in turn leads to higher levels of supply chain performance. The results did not find direct impact of IT enablers on supply chain performance. It is found that IT enablers have an indirect impact on supply chain performance through partnership relationship.

The research has important implication for practitioners. First, it demonstrates that partnership relationship build on

trust, commitment and shared vision is more important in improving supply chain performance than the implementation of IT. Frequently, organizations have tended to focus on the applications of IT on SCM, they have not given enough attention to the development of partnership relationships. This phenomenon may reflect the nature of IT and partnership relationships. Compared to partnership relationships, IT can be more easily implemented, and its benefits are more tangible and measurable. The results of this study demonstrate to the practitioners that to achieve higher levels of supply chain performance, an effective partnership relationship is a must. Therefore, it would be worthwhile for organizations that are contemplating improving supply chain performance to spend time and effort to build good relationships with their supply chain partners.

In addition, the findings of this research show that the impact of IT enablers on supply chain performance is not direct but indirectly through partnership relationship. Therefore, organizations should focus on implementing SCM software that is conductive for building good relationship with their supply chain partners. One solution may be to implement inter-organizational information systems that can communicate/coordinate with supply chain partners (such as CRM, SCM, etc), instead of internal systems (ERP, Intranet, Data Warehouse etc.) aiming at improving internal business processes.

Moreover, the data for the study consisted of responses from single respondents in an organization which may be a cause for possible response bias. The results have to be interpreted taking this limitation into account. The use of single respondent may generate some measurement inaccuracy. Future research should seek to utilize multiple respondents from each participating organization to enhance the research findings.

Appendix A: Items for Supply Chain Performance, IT Enablers and Partnership Relationships

Supply Chain Performance

Customization Flexibility: our supply chain is able to handle difficult nonstandard orders; our supply chain is able to meet special customer specification; our supply chain is able to produce products characterized by numerous features options, sizes and colors. *Volume and Launch Flexibility*: our supply chain is able to rapidly adjust capacity so as to accelerate or decelerate production in Response to changes in customer demand; our supply chain is able to rapidly introduce large numbers of product improvements/variation; our supply chain is able to handle rapid introduction of new products. *Supply Chain Integration:* there is a high level of communication and coordination between all functions in our firm; cross-functional teams are frequently used for process design and improvement in our firm; there is a high level of integration of information systems in our firm; there is a great amount of cross-over of the activities of our firm and our trading partners. *Customer Responsiveness*: our firm fills customer orders on time; our firm has short order-to-delivery cycle time; our firm has fast customer response time. *Supplier Performance*: our suppliers deliver materials/components /products to us on time; our

suppliers provide dependable delivery to us; our suppliers provide materials/components/products that are highly reliable; our suppliers provide high quality materials/component/ products to us. *Partnership Quality*: we believe our relationship with our trading partners is profitable; we and our trading partners share any risk that can occur in the supply chain; we and our trading partners share benefits obtained from SCM; our relationship with trading partners is marked by a high degree of harmony; our overall relationship with trading partners is satisfactory.

IT Enablers

Communication Tools: the extent of the usage of EDI in your firm to facilitate supply chain management; the extent of the usage of EFT in your firm to facilitate supply chain management; the extent of the usage of intranet in your firm to facilitate supply chain management; the extent of the usage of extranet in your firm to facilitate supply chain management. *Resource Planning Tools*: the extent of the usage of MRP in your firm to facilitate supply chain management; the extent of the usage of MRPII in your firm to facilitate supply chain management; the extent of the usage of ERP in your firm to facilitate supply chain management. *Supply Chain Management Tools*: the extent of the usage of DRP in your firm to facilitate supply chain management; the extent of the usage of CRM in your firm to facilitate supply chain management; the extent of the usage of SRM in your firm to facilitate supply chain management; the extent of the usage of VMI in your firm to facilitate supply chain management; the extent of the usage of DW in your firm to facilitate supply chain management; the extent of the usage of SCM Software in your firm.

Partnership Relationship

Trust in Trading Partners: our trading partners have been open and honest in dealing with us; our trading partners respect the confidentiality of the information they receive from us; our transactions with trading partners do not have to be closely supervised. *Commitment of Trading Partners*: our trading partners have made sacrifices for us in the past; we have invested a lot of effort in our relationship with trading partners; our trading partners abide by agreements very well; we and our trading partners always try to keep each others' promises. *Shared Vision Between Trading Partners*: we and our trading partners have a similar understanding about the aims and objectives of the supply chain; we and our trading partners have a similar understanding about the importance of collaboration across the supply chain; we and our trading partners have a similar understanding about the importance of improvements that benefit the supply chain as a whole.

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