THE IMPACT OF IT IMPLEMENTATION ON SUPPLY CHAIN PERFORMANCE THROUGH SUPPLY CHAIN AGILITY, CAPABILITIES, AND INTEGRATION AS MEDIATING VARIABLES: A CONCEPTUAL MODEL

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ABSTRACT

Global supply chain management is the 21st century global operations strategy for achieving organizational competitiveness. Companies are attempting to find ways to improve their competitiveness by changing their global operation strategies that include the implementation of information technology (IT). In a competitive environment where supply chains compete against supply chains, supply chain agility, capabilities and integration using IT are important factors in order to improve supply chain performance. A thorough and critical review of literature is carried out with the objective of bringing out pertinent factors and useful insights into the impact of IT on supply chain performance. In this paper, some literatures available on IT in supply chain management area are critically reviewed to develop a new conceptual model for studying the impact of IT on supply chain performance.

Keywords*: IT, supply chain agility, supply chain capabilities, supply chain integration, supply chain performance*

1. INTRODUCTION

Nowadays, companies are in the race for improving their organizational competitiveness in order to compete in the 21st century global market. All companies are trying to improve their agility level with the objective of being flexible and responsive to meet the changing market requirements. This phenomenon is not surprising given that supply chain now has to compete with other supply chains. All these highlight the importance of information technology (IT) in integrating supply chain partners.

The use of IT is considered as a prerequisite for the effective control of today's complex supply chains. The implementation of IT in the SCM can enable a firm to develop and accumulate knowledge stores about its customers, suppliers and market demands, which in turn influence firm performance (Tippins and Sohi, 2003; Li et al., 2009; Vijayasarathy, 2010). Indeed, a recent study conducted by Forrester Research indicates that U.S. manufacturers are increasingly dependent on the benefits brought about by IT to improve supply chain agility, reduce cycle time, achieve higher efficiency and deliver products to customers in a timely manner (Radjou, 2003).

IT can play a significant role in supply chain operations. The research strategies for examining the relationship between SCM and IT range from surveys to case studies. Many previous research models shows that some (e.g. Lin et.al, 2002; Tippins and Sohi, 2003; Subramani, 2004; Kelle and Akbulut, 2005), have looked for direct links between IT practice in the supply chain and performance gains, while others have modeled the presence of mediators (e.g. Li et al., 2009) and moderators (e.g. Vijayasarathy, 2010) of the relationship between the two constructs.

In our study, we focuses on supply chain agility (ability to cope with unexpected challenges, and inherently more market oriented because they are better able to synchronize supply with demand), supply chain capabilities (the ability of an organization to identify, utilize, and assimilate both internal and external information to facilitate the entire supply chain activities), and supply chain integration (the ability of a firm to integrate exchange-related activities within functional departments and with supply chain partners). While those three variables are mentioned as mediating variables

between IT implementation (IT) and supply chain performance (SCP) have been studied previously (e.g. Stank et al., 2001; Rai et al., 2006; Li, et al., 2010), but there were no studies have investigated those variables together on the relationship between IT and SCP.

The main objective of this paper is to provide a new conceptual model that illustrates the impacts of IT in supply chain management area. This study seeks to extend our understanding of how IT implementation impacts on supply chain agility (SCA), capabilities (SCC), integration (SCI), and supply chain performance (SCP). We develop a set of hypotheses based on the literature to empirically test the indirect impact of IT implementation on SCP mediated by SCA, SCC, and SCI. It is hard to explain the IT impact on SCP in quantitative values as the interaction of IT and SCP is not clear; thus, the structural equation model (SEM) method will be used for evaluating the impact of IT on SCP.

The remainder of this paper is organized as follows. The next section presents the literature review that helps to underpin a new conceptual model and sets out the study's hypotheses. The research methodology is presented in the third section consists of the proposed research design and analysis method. The discussion about my contribution on conceptual model development is in section four followed by conclusion.

2. LITERATURE REVIEW AND HYPOTHESES

A conceptual model developed in this study is presented in Fig. 1. The framework proposes a conceptual model of the relationships among IT implementation, supply chain agility (SCA), supply chain capabilities (SCC), supply chain integration (SCI), and supply chain performance (SCP). According to this model, the implementation of IT can improve SCP not only directly, but also indirectly, via its impact on SCA, SCC, and SCI. A brief description of all constructs is provided in the following subsections. Based on the extant literature, a number of hypotheses are developed with respect to the proposed relationships among IT, SCP, SCA, SCC, and SCI.

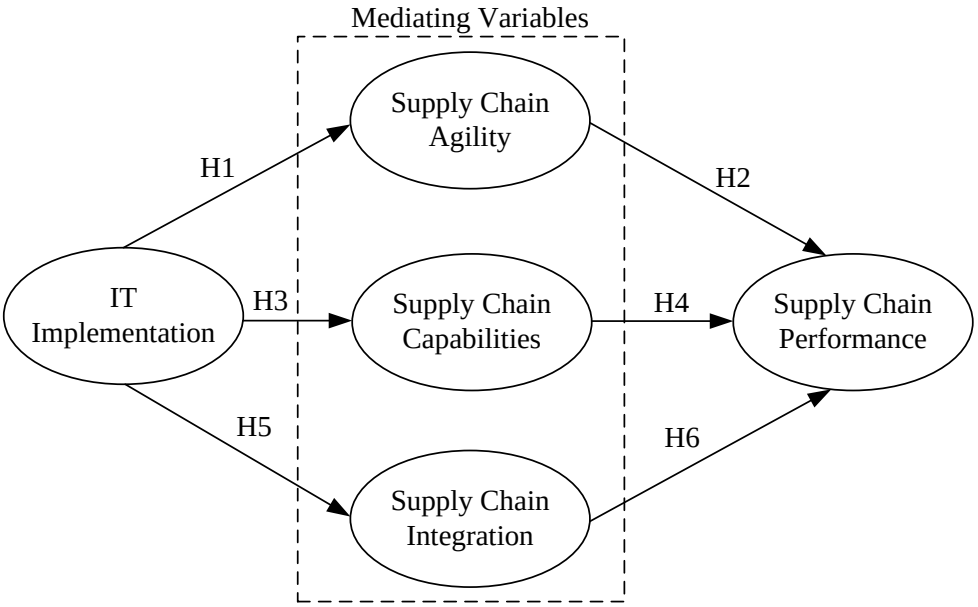

Figure. 1. The proposed conceptual model

2.1 IT Implementation, Supply Chain Agility, and Supply Chain Performance

To achieve a competitive edge in the rapidly changing business environment, companies must align with suppliers and customers to streamline operations, as well as working together to achieve a level of agility beyond individual companies. Consequently, agile supply chains are the dominant competitive vehicles (Lin et al., 2006). Being responsive is an increasingly important skill for firms in today's global

economy; thus firms must be agile. Naturally, it follows that an organization's agility depends on its supply chain being agile. However, achieving supply chain agility is a function of other abilities with in the organization, specifically information technology (IT) implementation.

IT provides the mechanism for organizations to effectively gather, store, access, share, and analyze data. As a component of a global supply chain strategy, IT implementation contains three integration elements: information flow integration, physical flow integration, and financial flow integration (Rai et al., 2006). While we do not make these fine distinctions, our IT implementation construct represents the extent to which IT is used to coordinate and integrate information within a firm's functions and with firms within their supply chain.

Information sharing also creates opportunities for increased supply chain agility (Mondragon et al., 2004). Also, higher levels of IT integration and the ability to share information in a real time manner helps an organization achieve higher levels of supply chain agility (Mason-Jones and Towill, 1999).

According to Lin et al.(2006), a firm's level of supply chain agility represents the strength of the interface between the firm and its markets. In this study, supply chain agility represents the speed with which a firm's internal supply chain functions can adapt to marketplace changes. It is captured by the speed of the supply chain in increasing product customization, improving delivery performance, and reducing development time, all critical for improved customer responsiveness (Mason-Jones and Towill, 1999). Based on the arguments above, our final hypothesis follows:

H1. Information technology implementation increases supply chain agility.

H2. Increased supply chain agility improves supply chain performance.

2.2 IT Implementation, Supply Chain Capabilities, and Supply Chain Performance

In the present study, we propose that supply chain capabilities serve as a mediating role between IT and supply chain performance. The IT implementation in supply chain management system can help build stronger supply chain capabilities in several ways. First, the IT implementation has the potential to enhance the speed, quality and quantity of information transferred. By accelerating the speed of information acquisition and information exchange, IT can ensure the availability and timeliness of relevant and important information to each party involved (Tippins and Sohi, 2003). Second, the deployment of an advanced IT in the supply chain system can achieve better coordination and reduce transaction costs (Subramani, 2004).

In the context of this study, enhancing supply chain capabilities can impact supply chain performance (Trkman et al., 2010). Supply chain capabilities can potentially improve a supply chain performance through a cost advantage over competitors. Capability of information sharing in the supply chain may reduce demand uncertainty, and the cost of inventories in the process of matching supply with demand in the supply chain network (Frohlich, 2002). It can also help a firm produce and deliver products or services to customers at lower cost and higher speed through the improvement in coordination between supply chain partners (Lin et al., 2002). Therefore, we believe the enhancement of supply chain capabilities through IT can have an impact on its supply chain performance. Based up on the above discussion, we posit:

H3. IT implementation affects supply chain capabilities positively.

H4. Supply chain capabilities of a firm affect its supply chain performance positively.

2.3 IT Implementation, Supply Chain Integration, and Supply Chain Performance

Supply chain integration refers to the ability of a firm to integrate exchange-related activities within functional departments and with supply chain partners. IT has vast potential to facilitate integration and coordination among functional departments and supply chain partners through the sharing of information on demand forecasts and production schedules that dictate supply chain activities (Li et al., 2009). Implementation of IT in SCM can integrate and coordinate the flow of materials, information, and finances among suppliers, manufacturers, wholesalers, retailers and

end-consumers. Here, IT serves as a key enabler of supply chain integration through the capture, organization, and sharing of vital information regarding key business processes, both within and outside an organization's boundaries (Kelle and Akbulut, 2005).

A firm that is pursuing the effective construction of SCM practices needs to pay attention to supply chain integration. SCM practices implemented to achieve superior supply chain performance (cost, quality, flexibility and time performance) require internal cross-functional integration within a firm and external integration with suppliers or customers to be successful (Kim, 2009).

Supply chain integration (SCI) is enhanced by sharing information about key processing activities. With high degree of SCI, manufacturers can react more flexibly to individual customer demands, to decreased delivery times, and to reduced inventories, all of which can make the supply chain more efficient (Li et al., 2009). Enhanced integration across an individual firm's functions and along its supply chain can be expected to impact many dimensions of performance, including cost, quality, delivery, flexibility, and profits (Stank et al., 2001). On the basis of the foregoing, we propose the following hypothesis:

H5. IT implementation has a positive effect on supply chain integration.

H6. Supply chain integration has a positive effect on supply chain performance.

The indicators of each construct are presented in Table 1.

3. RESEARCH METHODOLOGY

3.1 Proposed Research Design

The aim of this literature study is to explain the impact of IT implementation on supply chain performance (SCI), via its impact on supply chain agility (SCA), supply chain capabilities (SCC), and supply chain integration (SCI) as mediating variables. This study couldn't be restricted only to one kind of firm. Both the manufacturing and service companies are willing to cooperate and to provide to conduct a survey. The questionnaires can be subsequently contacted through postal mail, e-mail and/or telephonically to explain the context of the present study, and to clarify any queries/doubts to facilitate comprehensive and clear-cut responses to the questionnaires. All of the possible respondents will be provided a standardized questionnaire depend on their work responsibility in companies. The highest-ranking officers (e.g. president, CEO, vice president, or senior manager) of the targeted companies were contacted first, after which, contact was made with a middle-manager (e.g. supply chain manager, logistics manager, procurement/purchasing manager, or IT manager) responsible for the company's supply chain activities. Since all of our respondents were corporate managers familiar with their company's supply chain activities, it is reasonable to expect that the respondents could offer a deep insight into the supply chain activities.

Table 1. The indicators of each construct

Constructs	Indicators/Items
IT Implementation (IT)	IT1: Electronic data Interchange (EDI) coverage IT2: Usage of bar Coding/automatic identification and data capture IT3: Effective usage of computers in operations and decision-making IT4: Open standards and unique identification codes IT5: Decision-making systems and support to supply chain partners
Supply Chain Agility (SCA)	SCA1: Speed in reducing manufacturing lead time SCA2: Speed in reducing development cycle time SCA3: Speed in increasing frequencies of new product introductions SCA4: Speed in increasing levels of product customization SCA5: Speed in adjusting delivery capability SCA6: Speed in improving customer service

Table 1. The indicators of each construct

Constructs	Indicators/Items
	SCA7: Speed in improving delivery reliability SCA8: Speed in improving responsiveness to changing market needs
Supply Chain Capabilities (SCC)	SCC1: Information exchange SCC2: Coordination SCC3: Activity integration SCC4: Responsiveness
Supply Chain Integration (SCI)	SCI1: Strategies for optimizing logistics system resources based on DFL SCI2: Understanding of market trends and accuracy of demand forecasting SCI3: Accuracy and adaptability of SCM planning SCI4: Control and tracking of inventory: accuracy and visibility SCI5: Process standardization and visibility
Supply Chain Performance (SCP)	SCP1: Just-in-time SCP2: Inventory turnover and cash-to-cash cycle time SCP3: Customer lead time and load efficiency SCP4: Delivery performance and quality SCP5: Supply chain inventory visibility and opportunity costs SCP6: Total logistics cost

3.2 Analysis Method

We use structural equation modeling (SEM) as statistical technique for testing and estimating causal relationships using a combination of statistical data and qualitative causal assumptions (Hair et al., 2010). Our proposed conceptual model focused on understanding the nature of the impact of IT on SCP through SCA, SCC, and SCI as mediating variables. Through SEM using AMOS or LISREL software, we can test our specified framework or hypothesized relationships among those variables (refer to Fig. 1). We will evaluate our measurement model and considered the relationship between a construct and its indicators e.g. IT implementation and its indicators. We also will test our specified hypotheses between the latent IT, SCA, SCC, SCI, and SCP constructs.

By using the goodness of fit indicators, we are able to isolate where fit and lack of fit arise in the conceptual model and can test hypotheses (Hair et al., 2010). We will review our analysis results and discuss the meaning of the results. The results of the SEM analysis allow us to describe the correlation between variables, to understand which indicators best explain the construct, and also to understand the relationship between IT implementation and SCP because of SCA, SCC, SCI as mediating variables.

4. DISCUSSION

The several journals have been highlighted the contributions of various IT implementation initiatives for accruing strategic benefits in supply chain management. Our proposed research here is to further explain the relationship between IT practices and supply chain performance. In particular, we plan to identify the implementation of IT, and test its interrelationship and impact on supply chain performance. But, we would like to investigate their nature of the relationships through mediating variables (SCA, SCC, and SCI).

In order to ascertain the benefits realized by an effective IT implementation, it becomes imperative that the mediating variables be scrutinized carefully to analyze the contributions made by IT implementation on supply chain performance. In this proposed research, five key IT implementation indicators (IT1, IT2, IT3, IT4, and IT5) and six supply chain performance parameters (SCP1, SCP2, SCP3, SCP4, SCP5, and SCP6) have been identified as significant for analyzing the impact of IT

implementation towards achieving supply chain performance improvements through supply chain agility, capabilities, and integration as mediating variables. These relationships can be used to understand the effect of various IT implementations towards realization of organization objectives of growth and sustainability.

Based on this research, the writer recommends that practitioners can use this conceptual model to evaluate their IT practices and their impact to supply chain performance. Hopefully, this proposed model also can be used to investigate the role of various IT implementation initiatives in achieving significant supply chain performance improvements in the companies. For this purpose, various IT implementation initiatives and supply chain performance parameter categories can be established in the research. The empirical evidence can be presented to support relationships between critical types of IT implementation and key supply chain performance enhancement parameters. Beside that, this proposed research is hoped to support and encourage successful implementation of IT and the findings about effective IT implementation can significantly contribute towards realization of supply chain performance improvements for competing in the highly dynamic global marketplace.

5. CONCLUSION

Customers' expectations are also increasing and companies are prone to more and more uncertain environment. Being responsive is an increasingly important skill for companies in today's global economy; thus the company must be agile. Achieving supply chain agility is a function of other abilities with in the organization, specifically supply chain flexibility and information technology (IT) integration. The strategic and technological innovations in supply chain will impact on how organizations buy and sell in the future.

However clear vision, strong planning and technical insight into the IT capabilities would be necessary to ensure that companies maximize the IT potential for better supply chain management and ultimately improved competitiveness. Internet technology, world wide web, e-commerce etc. will change the way a company is required to do business. These companies must realize that they must harness the power of IT to collaborate with their business partners. That means using a new breed of IT application, to observe past performance and historical trends to determine how much product should be made as well as the best and cost effective method for warehousing it or shipping it to retailer.

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