Investigation of Possible Barriers and Integration of Information Technology in Supply Chain Management

Khalid Hussain Ansari[1] and Ashutosh Samadhiya[2]
[1,2] Assistant professor, Department of Mechanical Engineering,
Rama University, Kanpur, India
khalidmech@rediffmail.com
ashutosh.mechanical2658@gmail.com

Abstract— In today's competitive business environment, companies are trying to provide customer faster services less expensively than their competition. Integrated information system in the form of supply chain technology is the efficient key, since it increases the efficiency of information systems and results in more efficient management processes. The investigation on the impact of technological implementation of practices would provide both interpretative and quantitative models to measure the achievable benefits of technological adoption, to overcome adoption barriers, and to help managers decide whether to invest in technology.

Keywords—Supply Chain Management, Information Technology, Supply Chain Technology, Coomunication Technology, Information flow.

I. INTRODUCTION

SCM is well characterized by the complication of the multiple relationships and interactions between trading partners. These interactions are not just complicated by their volume and variation in processes, but also by the complexity which exists between parties in space and period. Moreover, companies have limitation in their ability to work with global partners because of language barriers and time differences. (Power and Sohal, 2002)

SCT is found as a tool which is not only to improve the effectiveness and efficiencies of the operations but also act as a competitive weapon to the organizational strategy. Moreover, SCT is critical to reduce costs and enhance the competitiveness. In order to encourage the growth and widespread the adoption of SCT amongst Indian organization, the identification and analysis of factors that affect the adoption of SCT should be identified (Power, 2005)

The sharing of information across the SC requires arrangement between the SC participants. Information flow, information visibility, and information rate are important concepts to enable information driven SC.

Information Technologies allow organizations for the transmission and processing of information which are necessary for synchronous decision making between SC partners. Such integration enables these SC members to coordinate the flow of materials to be smooth; thus, reducing the need for inventory due to risk of disordered supply. Therefore, Information and Communication Technologies have been applied in building information integration between organizations and their SC partners. (Prajogo and Sohal, 2008)

II. LITERATURE REVIEW

As the need for Information Technology integration in SC increases, building integration within SC partners has become essential in such a manner that organizations cannot afford to ignore. In this regard, Information Technology in SC enables real-time collaboration and integration between SC partners by providing organizations with forward visibility, which allows them to improve their production planning, inventory management and distribution.

Technological innovation in services is often based on the adoption of Information technology and is strongly associated with higher levels of productivity in firms (Cainelli et al., 2004). The globalization of SC architectures requires that information is shared and managed internationally (Barbosa and Musetti, 2010). A common view is that information technology has a profound impact on the management of SCs as new technologies greatly facilitate the flow of information, as well as extending control over remote operations and across organizational boundaries (Schary and Skjøtt-Larsen, 2001).

The focus of this literature review also is to examine barriers to Information technology integration. The main barriers to Information technology integration discussed here are lack of strategic alignment of information strategies in the chain, firm size, lack of awareness of the potential benefits of Information technology, lack of motivation.

It has been argued in the literature that greater advantage of technology can be obtained when applied and integrated throughout a SC. Technology can also support SC integration (Christopher, 2000; Croom, 2005; Cagliano et al., 2005; Power, 2005). This could benefit competitiveness if taking the viewpoint that SC competes instead of organizations (Christopher and Ryals, 1999). Despite the potential benefits of SCT solutions, organizations in the private and public sectors are still careful (Zheng et al., 2004).

TABLE I**:** Information on the common Information Technologies

Type of Software Package	Explanation	Key Benefit(s)
Electronic Data Interchange (EDI)	The computer-to-computer exchange of business information using a Standardized data format. Standardized EDI messages are based on common Business documents such as purchase orders, invoices and bills of lading and are sent from one computer application to another over telecommunications links without human involvement.	Speed and accuracy of data transmission
Radio frequency Identification (RFID)	The technology uses radio waves to transfer detailed information from tags, programmed with a unique number and attached to items to a company information system. The tags are superior to bar codes labels in that they allow significantly more information to be stored and have the capacity to easily update or alter information at any point along the supply chain without having to change the tag.	Improves efficiency of inventory location and management Processes
Enterprise	ERP offers a centralized system to control information flow	Integrates business

Resource Planning System (ERP)	through a Manufacturing environment. ERP covers functions such as capacity planning, cost and accounting, order entry, production management, inventory and finance.	functions; allows data to be shared across company
Customer Relationship Management (CRM)	These systems are computer-based applications used to improve the selling and the revenue generation process of an organization. They are particularly concerned with the relationship of the organization to its customer. They provide support for the provision of a service to a customer by collecting customer data and providing information about a customer. They help organizations to become more customer oriented.	Greater customer loyalty
Automated quality Control Systems (AQC)	Automated quality monitoring and inspection devices observe the quality of in process work in automated manufacturing systems. They are used to determine the acceptance or rejection of a work piece or a specific production long before work pieces are advanced to the next process.	Improves product/service quality
Warehouse Management Systems (WMS)	WMS track and control the movement of inventory through the warehouse, from receipt to shipping. WMS manages utilization of resources such as space and personnel. It also offers systematic management of material handling to optimize and shorten fulfillment cycle time, so reducing cost.	Reduces storage and handling costs
Transportation Management Systems (TMS)	TMS are intended to achieve enterprise-wide load control centres by allowing companies to address the complex requirements of transportation between channel partners. TMS solutions can offer cultured planning procedures to optimize different shipping circumstances.	Reduces transportation assets; provides greater customer service
Geo-Coded Tracking Systems	Satellite or cellular tracking devices most commonly used in trucks or trailers to identify position and feed the information to additional systems such as TMS, routing or WMS via internet to customers, who can track their goods on line.	Improves efficiency of location used in identifying customer goods via internet
Barcode systems	Systems or products that are used in conjunction with any of the above Systems to produce barcodes for any purpose	Eliminate Data Entry Errors

III. OBJECTIVE OF THE STUDY

The objective of the present study is to measure the degree of SCM technology adoption and to identify barriers to the use of information technologies within supply chain management amongst Indian manufacturing organizations.

The major objectives of present research are listed as follows:

- To identify the types of information technologies currently in use amongst users in supply chain management.

- To investigate the degree of Information Technology integration between SCM partners.
- To identify the Benefits provided by the adoption of IT in SCM
- To identify barriers to the use of supply chain technologies within supply chain management.

IV. SUPPLY CHAIN MANAGEMENT (SCM)

SCM can be defined as the configuration, coordination and continuous improvement of a sequentially organized set of operations. The goal of SCM is to provide maximum customer service at the lowest cost possible. Generally, materials, information, capital, labour, technology, financial assets and other resources flow through the SC (Tarofder et al. 2012).

The major activities involved in SCM include delivering a product from raw materials to the customer, including sourcing raw materials, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, delivery to the customer, and the information systems necessary to monitor all of these activities. SCM coordinates and integrates all of these activities into a unified process. It links all associates in the SC including parties within an organization and the external partners, including suppliers, transporters and third-party companies (Lummus and Vokurka, 1999)

TABLE II: Definitions of SCM

Reference	Definition of SCM
Blos (2009)	The management of material, information and finance through a network of organizations that aims to produce and deliver products or services for the consumers.
Awad (2010)	SCM is facilitating system for inter-enterprise corporation and collaboration with supplier, customer and business partner
Pienaar (2009)	SC as a general description of the process integration involving organizations to transform raw material into finished goods and transport them to the end user.
Kampstra (2006)	Integration of all activities associated with the flow and transformation goods, information, and the associated funds, through improved SC relationships of all involved entities
Leger (2006)	A firm may use information gathered from upstream E-collaboration to make important downstream decisions and vice versa
Vonderembse (2006)	SCM is the approach to designing, organizing and executing all the activities from planning to distribution along the entire value chain, including the network of suppliers, manufacturers and distributors.
Lambert and Cooper (2000)	SCM is the relationships, both between corporate functions and across companies.
Fiala (2005)	SC is broadly defined as system of suppliers, manufacturers, distributors, retailers and customers where material, financial and information flows connect participants in both directions
Love (2004)	It is the network of facilities and activities that provide customer and economic value of the functions of design, development, contract management, service and material

	procurement, materials manufacture and delivery and facilities management
Lummus (2003)	SCM is a combination of all different processes and activities that produce value in the hand of ultimate customers.
Hugos (2011)	SCM is the coordination of production, inventory, location and transportation among the participants in a SC to achieve the best mix of responsiveness and efficiency for the market being served
Frohlich and Westbrook (2001)	It is the arcs of integration to characterize the extent to which firms integrated with upstream and downstream partners
Mentzer (2002)	SCM is the management of the network of interconnected business involved in the ultimate provision of product and service packages required by end customers
Simchi-Levi and Zhao (2003)	It is the interaction among different companies that aim to aggregate value to end customer

V. SUPPLY CHAIN TECHNOLOGY

Use of technologies in SCM can bring operational benefits like cost reduction and service improvements and strategic benefits such as improvements in product planning and innovation. The information technology provides ability to SC partners which includes quickly adjusting inventory levels, adding or reducing shippers when needed, increasing the speed in reacting to customer service problems, managing distant facilities more effectively, reducing the level of paper work in a SC system, adjusting material amount when necessary, tracking shipments more accurately, developing cost effective purchasing strategies, improving production scheduling and reducing operational redundancy in SC systems (Lancioni et. al., 2000).

In order to integrate SCM and SCT adoption, SCT can be categorized into functional technologies and integrative technologies. Functional technologies refer to systems that are used to achieve a particular functional area such as warehouse management systems (WMS) and transportation management systems (TMS). Meanwhile integrative technologies refer to activities relating to coordinating and integrating information flows and activities within and/or between organization boundaries (Patterson et al. 2003).

VI. METHODOLOGY

With the reference to the research and objectives above, the research study approach will allow the aspects of the problem of identifying the variables that positively influence the decision to accept, adopt or implement information technology in supply chain management to be studied in depth.

The research methodology is based on empirical data collected through a questionnaire survey. The questionnaire had to be clear and brief to ensure that the respondent would not be confused with the questionnaires. Clear instructions were added in the questionnaire and all the possible answers had to be answered by the respondent while answering the questionnaire. The survey includes organizations from sectors, namely Manufacturing (Automotive), Leather Industry, Garments, Servces Others. Before sending the questionnaire to the organizations, a pilot study was carried out, to add questions, if any, missing from the questionnaire, to delete any irrelevant questions, and to refine the language of the existing questions to bring more clarity to the questionnaire.

VII. FINDINGS

A survey package was sent to the 98 organizations in India. Out of 98, only 71 had replied the questionnaire. This yielded a total of 71 responses for a response rate of 72.44 percent

Table 1 Industrial sectors involved in the surveyed companies

Sector	Percentage
Manufacturing (Automotive)	18
Leather Industry	27
Manufacturing (garments)	21
Services	20
Others	24

In this research the respondents have a very significant role to play in expressing and giving the responses about the problem, benefits, keeping this in mind, in this study a set of personal characteristic position, education, experience and age group of the respondents have been also examined. The data appropriate to the outcomes of Information Technologies integration SCM in different organizations are presented in the next sections.

INTEGRATION OF IT IN SCM

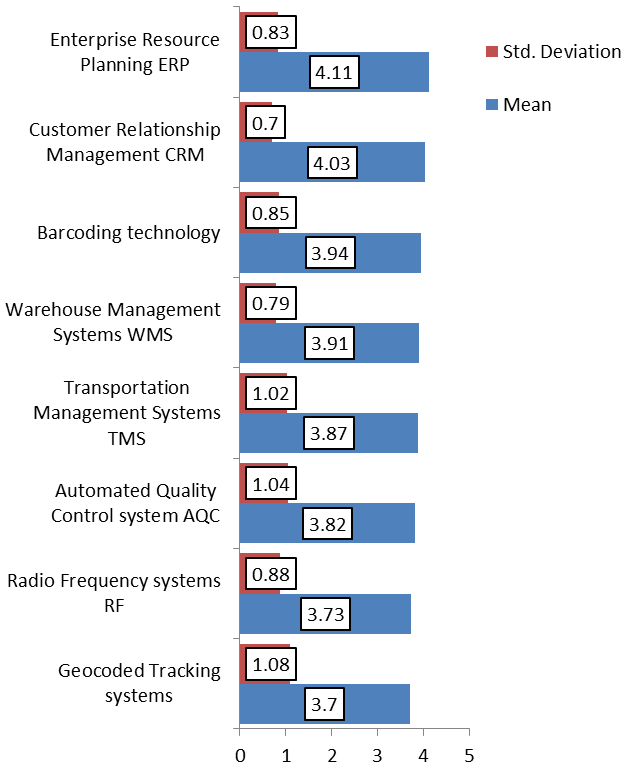

Fig.1: Integration of IT in SCM

SC activities involve a chain of values somewhere along the its operation. Therefore, IT can be used as a tool to create efficiency and effectiveness in the value chain activities. Therefore, respondents were called for sharing their practices of various types of IT application in different parts of SCM.

The findings suggested that Enterprise Resource Planning (Mean = 4.11; SD = 0.83), Customer Relationship Management (Mean = 4.03; SD = 0.70), Customer Relationship Management (Mean = 4.01; SD = 0.96) and Bar coding technology (Mean = 3.94; SD = 0.85) are highly used IT application in SC. This followed by Transportation Management System (Mean = 3.87; SD = 1.02), Automated Quality Control system (Mean = 3.82; SD = 1.04), Manufacturing Execution System (Mean = 3.79; SD = 1.11), Radio Frequency system (Mean = 3.73; SD = 0.88). Whereas Geo-coded Tracking systems (Mean = 3.70; SD = 1.08) and Warehouse Management Systems (Mean = 3.66; SD = 1.03) are the least adopted IT technologies in SCM.

BENEFITS OF IT IN SCM

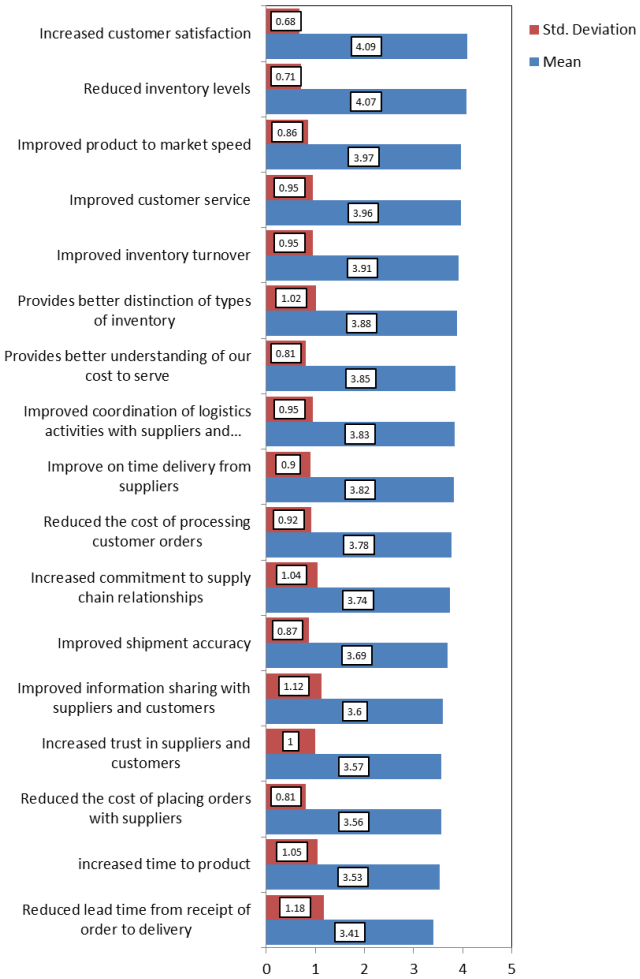

Fig.2: Benefits provided by the adoption of IT in SCM

It has been found that the organizations which had adopted SCT gain benefits in almost every area of the SCM. Top most benefits under these adoptions have increased customer satisfaction (Mean = 3.94; SD = 0.95), reduced inventory levels (Mean = 3.97; SD = 0.94), Improved product to market speed (Mean = 3.86; SD =

1.05), Improved customer service (Mean = 3.85; SD = 1.03) Improved inventory turnover (Mean = 3.91; SD = 0.95). This is followed by other benefits like, Provides better distinction of types of inventory (Mean = 3.88; SD = 1.02), Provides better understanding of our cost to serve (Mean = 3.79; SD = 0.99), improved coordination of logistics activities with suppliers and customers (Mean = 3.83; SD = 0.95), Improve on-time delivery from suppliers (Mean = 3.72; SD = 0.98), Reduced the cost of processing customer orders (Mean = 3.78; SD = 0.92), Increased commitment to SC relationships (Mean = 3.66; SD = 0.92); Improved shipment accuracy (Mean = 3.9; SD = 0.87), Improved information sharing with suppliers and customers (Mean = 3.5; SD = 1.09). Whereas some benefits which are least experienced by the respondents are Increased trust in suppliers and customers (Mean = 3.56; SD = 1.01), Reduced the cost of placing orders with suppliers (Mean = 3.53; SD = 0.99), Increased time to product (Mean = 3.7; SD = 0.95), Reduced lead time from receipt of order to delivery (Mean = 3.74; SD = 0.86).

BARRIERS TO ADOPT IT IN SCM

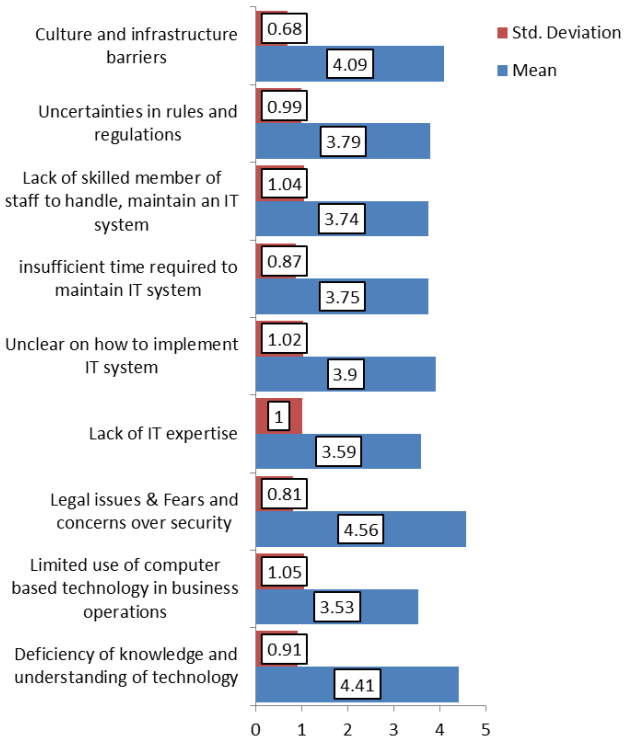

Fig.3: Barriers to adopt IT in SCM

It has been found that possible barriers that influenced most are Legal issues & Fears and concerns over security (Mean = 4.56; SD = 0.81), Deficiency of knowledge and understanding of technology (Mean = 4.41; SD = 0.91) and Culture and infrastructure barriers (Mean = 4.56; SD = 0.81). This is followed by other barriers like, Unclear on how to implement IT system (Mean = 3.90; SD = 1.02), Uncertainties in rules and regulations (Mean = 3.79; SD = 0.99) and Insufficient time required to maintain IT system (Mean = 3.75; SD = 0.87). Whereas some barriers which are least experienced by the respondents are

Lack of skilled member of staff to handle, maintain an IT system (Mean = 3.74; SD = 1.04), Lack of IT expertise (Mean = 3.59; SD = 1.0), Limited use of computer based technology in business operations (Mean = 3.53; SD = 1.05) = 0.98), Reduced the cost of processing customer orders (Mean = 3.78; SD = 0.92), Increased commitment to SC relationships (Mean = 3.66; SD = 0.92); Improved shipment accuracy (Mean = 3.9; SD = 0.87), Improved information sharing with suppliers and customers (Mean = 3.5; SD = 1.09). Whereas some benefits which are least experienced by the respondents are Increased trust in suppliers and customers (Mean = 3.56; SD = 1.01), Reduced the cost of placing orders with suppliers (Mean = 3.53; SD = 0.99), Increased time to product (Mean = 3.7; SD = 0.95), Reduced lead time from receipt of order to delivery (Mean = 3.74; SD = 0.86).

It has been found that the organizations which had adopted IT in SCM influenced in almost every area of the SCM. Top most influenced under these adoptions have increased customer satisfaction (Mean = 3.94; SD = 0.95), reduced inventory levels (Mean = 3.97; SD = 0.94), Improved product to market speed (Mean = 3.86; SD = 1.05), Improved customer service (Mean = 3.85; SD = 1.03) Improved inventory turnover (Mean = 3.91; SD = 0.95). This is followed by other benefits like, Provides better distinction of types of inventory (Mean = 3.88; SD = 1.02), Provides better understanding of our cost to serve (Mean = 3.79; SD = 0.99), improved coordination of logistics activities with suppliers and customers (Mean = 3.83; SD = 0.95), Improve on-time delivery from suppliers (Mean = 3.72; SD = 0.98), Reduced the cost of processing customer orders (Mean = 3.78; SD = 0.92), Increased commitment to SC relationships (Mean = 3.66; SD = 0.92); Improved shipment accuracy (Mean = 3.9; SD = 0.87), Improved information sharing with suppliers and customers (Mean = 3.5; SD = 1.09). Whereas some benefits which are least experienced by the respondents are Increased trust in suppliers and customers (Mean = 3.56; SD = 1.01), Reduced the cost of placing orders with suppliers (Mean = 3.53; SD = 0.99), Increased time to product (Mean = 3.7; SD = 0.95), Reduced lead time from receipt of order to delivery (Mean = 3.74; SD = 0.86)

VIII. OUTCOMES AND DISCUSSION

Information Technology provides organizations with significantly increased strategic options for achieving long term flexibility and adaptability. With the growth of SCT, customers are demanding faster turnaround and greater customization than ever before. At the same time, organizations are looking for innovative ways to make their businesses more consumer-centric. They need to improve their relationships with customers to create customer loyalty and SCT is perceived as the vehicle to achieve this. SCT also levels the playing field between large and small organizations, allowing any size enterprise to access suppliers and customers around the world.

IX. SCOPE FOR FUTURE WORK

Further studies can be made by considering some factors will reveal much more interesting facts. It will be beneficial to include a customer and supplier perspective in future studies. This will improve the understanding of mechanisms that allow the use of technology to bring benefits to service providers and customers.

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