ROLE OF INFORMATION TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT

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ABSTRACT

Information Technology revolution changed the world and all aspects of business processes. The developments in Information technology has resulted in many possible alternative solutions for managing the supply chain effectively.Supply chain management is information driven function. Information Technology enabled supply chain management will provide a competitive advantage to an organization over rest of the competitors in market place. IT plays a vital role in decision making process. IT is beneficial for cooperation and coordination within the supply chain. This paper highlights the overview of information technology for effective supply chain management, software focused supply chain characteristics as well as IT tools used in IT enabled supply chain management.
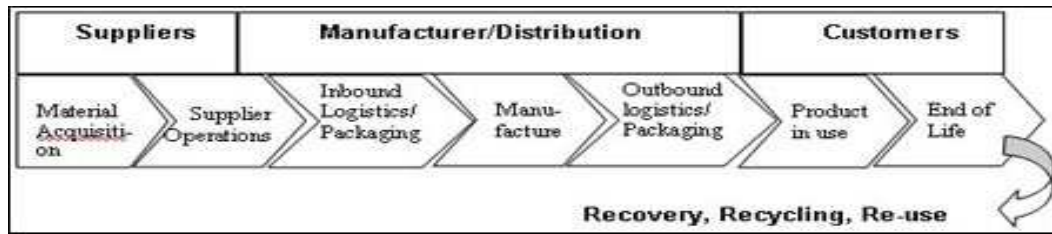
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1. INTRODUCTION

Every organization is struggling in order to survive in today's competitive marketplace. Traditional supply chain working is not going to help an organization to cope up with market demands and customers. IT revolution changed the face of supply chain which was used to be few years back. IT provides an organization to have a smart and robust supply chain. The challenge lies in creating economic value through vibrant organizations, innovations and applications of strategic tools.Indian supply chain industry is still under development and has understood the role of information technology in supply chain.

Information technology plays a vital role in enhancing the supply chain driver's performance. Information Technology is the use of inter organizational systems that are used for information sharing and/or processingacross organizational boundaries.There is an ever increasing need for fully integrated supply chain management solutions which incorporate all the functionality of network strategy, configuration of supply chain, planning of demand, transportation and warehouse management systems for any organization.

Supply chain management is a management of network of interconnected business involved in the ultimate provision of product and service packages required by end customers. Supply chain management consists of flow of goods, information and funds. Main objective of supply chain is to enhance supply chain profitability and IT helps to achieve the same thing. IT plays a crucial role in supply chain decision phase which can be categorized as design, planning, or operational depending upon the time frame during which decision made apply.
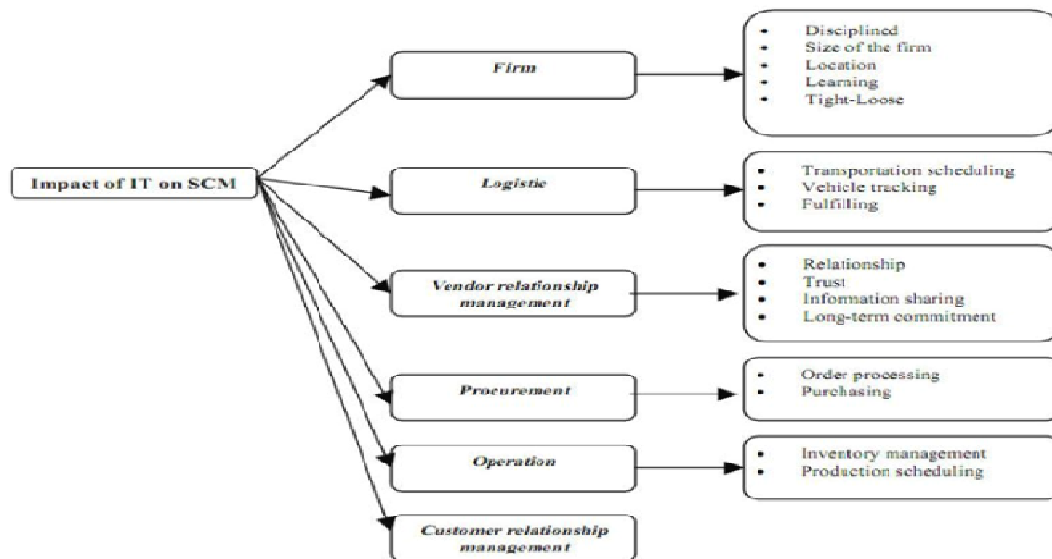
Fig 1: Supply chain management phases

Supply chain execution is managing and coordinating the movement of information, funds and materials across the supply chain. The flow is bidirectional and it consists of information, management of inventory and flow of cash. Recent developing's in technology enable the organization to avail information easily in their premises andis helpful to coordinate the activities to manage the supply chain. The information cost is decreased due to increasing rate of technologies. Supply chain manager's needs to understand that information technology is more than just computers.

2. INFORMATION AND ENABLING TECHNOLOGIES

Information affects every part of the supply chain. Information serves as the connections between various stages of the supply chain, allowing them to coordinate, maximize the supply chain profitability. Information is also important to the day today operation of each stage in supply chain. To become more responsive and efficient, companies need to consider information as an important driver, information plays vital role in competitive strategy. Timely and accurate information is more critical now that at any time. Three factors have strongly impacted this change in the importance of information.

- Customerexpectations have to be fulfilled.
- To reduce human resource requirements and inventory to a competitive level.
- Information is important in strategic planning and deployment of resource.

Fig 2: Adopted from Fasanghari R. and Kamal, C. (2008): Assessing the impact of information technology on supply chain management

2.1 The Impact of IT on organizations

It was addressed by Alter (2002), Information systems: Foundations of e-business that the Information systems have had a huge impact on the business operation. Initially; employees had limited access to the data stored within them. As technology advanced, data storage has become more prevalent within organizations. With network of PC'S, employees can now access information and information systems with an ease that was just not possible ten years ago, the study shows the impact of technology on business on the two main areas:

1) Economic Impact: By using appropriate materials and information systems, the organization can save resources and material, as well as staff time. Moreover administrative duties areperforming with less effort, easier and less time-consuming through the introduction of suitable information systems.

2) Organizational Change: the study shows the following factors to be considered when planning a new information system:

- The environment in which the organization operates.
- The structure of the organization.
- The culture and politics of the organization.
- The style of management.
- The people affected by the organization – its employees and other interested parties.
- The goal of the information system – what is the task, decision, business process ….etc. that this information system is supposed to assist with?

3. PROPOSED MEASUREMENT FRAMEWORK FORSOFTWARE FOCUSED PRODUCTS AND SERVICE SUPLLY CHAIN

To win in the competitive global market, enterprises are trying to sell personalized products or services exactly suited to a customer's desires or needs. For many products, the personalization, customization and differentiation are realized through software components in the products. The hardware components are becoming commodity. It has been a trend that the software constitutes the major innovation and value. The real value of a product is determined by thesoftware configuration and customization. To design, manufacture and deliver such products, a software focus supply chain should be formed to effectively and efficiently achieve the goal. Such supply chain is only received attention recently. It is necessary for us to understandthe characteristics of SW-focused supply chain and what important measurement metrics are for SW-focused supply chain management and improvement. Software supply has big impacts on the overall supply chain performance. For instance, the final invoicing is not made when hardware is on site but when the customized software is installed and running without problems. To reduce 'Time to Cash', the lead-time of SW supply and delivery is crucial. The sourcing, production and distribution of software are becoming more important from both a costmanagement and revenue generating perspectives. Major industry players are shifting from selling "boxes" to selling functionality. Supply chain management is moving its focusfrom material flow to product flow that contains software components.

4. FRAMEWORK

Today's business is trying to provide customers with personalized products to win orders. With the technology development, business is applying software technology to achieve this. The personalized product has been more and more recognized as order winner. But the great level of varieties of products will increase the supply chain cost and affect customer service level. When more companies can offer the variety, the capability of supply chain delivering products faster and efficient will become the new order winner. To remain in business, an organization must always concern its bottom-line. The supply chain should be formed with optimal resources to reduce the cost. Only profitable supply chain can survive in the competition. In the framework,all the issues should be addressed. Considering the SW-focused supply chain characteristics, we proposed three dimensional performance measurements: Resources, Visibility and Agility.

4.1 Resource Measurement

Resource measurement is the basic measurement for anycompany or any supply chain. It concerns the supply chainbottom line. It is an important part of the measurement system.

Resources are generally measured in terms of theminimum requirements (quantity) or a composite efficiencymeasure. The goal of supply chain analysis is to minimize resource requirements.Followings are some supply chain resource measures:

1. **Total resource cost**: Total cost of resources includingpeople, software installation, materials and etc.

2. **Distribution cost**: Total distribution cost, includingtransportation, installation, and integration of softwarewith hardware.

3. **Inventory cost**: Cost associated with inventory, includingthe inventory cost for both hardware andsoftware.

4. **Cost of goods sold**: The total cost associated withthe production of the goods, including materialcost, overhead and software cost such as loyaltyfee.

5. **Return on Investment (ROI)**: The ratio of net profitover total assets.

4.2 Visibility measurement

Visibility defines the right of 'knowing' for both supplychain partner and customers. It is important for customers toknow their order status to make right decision or simply tobe assured. This is very important part of customer satisfaction.The visibility is realized through integrating internalsystems and trading partners in a zero-latency messagingenvironment, and enabling real-time visibility and performancemonitoring on the movement of goods and events inthe fulfillment network (both inbound and outbound). Thevisibility of a supply chain is determined by the informationflow among supply chain partners and customers. The advancementsof Information and Communication Technology (ICT)has enabled partners to exchange real-time information onthe planning and execution of their respective supply chainsusing a variety of underlying messaging and dialog techniques.

The information flow can be measured in terms of quality,quantity and speed. The quantity measures how muchinformation is flowing among the partners and customers,and whether it is sufficient to meet all parties' needs. Thequality defines the accuracy of the information and the usefulness.The speed indicates if the information is transferredto right parties on time.

Speed alone is not sufficient to increase customers andpartners' confidence. Although there seems to be a naturaltendency to expect higher speed from an electronic medium,this expectation does not seem to translate into thingslike shipping lead times. Customers seem to be quite happyto accept the speeds that are commonly delivered by companies.What they are not prepared to accept is the promisethat is not kept. In other words, it is quite acceptable to offer a standard service level of five to seven days for delivery.It is not acceptable to miss that offer by even a singleday. Whatever is promised must be delivered - without fail!

What should be taken to keep promises? Fundamentally,seven activities must be integrated in order to make servicepromises that have the potential to be kept by an organization.These include activities such as delivery capability,order management, inventory management, capacity management,and customer service. But the most important isthe visibility of whole supply chain activities and events. Itwill help to provide an accurate promise and keep it.

4.3 Agility measurement

Agility is defined as the ability of an organization to respondrapidly to changes in demand both in terms of volumeand variety. Changes in demand may come in differentways, such as changes in volume, delivery dates, varietyof products, production. A significant change in demandmeans that the change is not just a one-off peak demandor downtime situation. Therefore using up any slackin capacity, issuing over time or subcontracting will notconsistently solve the situation. The inventory of raw materialsand WIP may not be able to cover the changes. Additionalarrangement with suppliers may have to be made. Itneeds to put longer term solutions in place to be able tocope with a significant change in demand.Agility is all about creating that responsiveness and masteringthe uncertainty. Agility implies end-to-end timecompression or postponement of final product configuration.It is very critical to SW-focused supply chain as thedemand for the products are more violate compare to otherproducts. The focus in SW-focused supply chain managementmay shift from cost saver as the order winner to responsivenessas the winner. The implication is that the emphasisin supply chain performance measurement must beon agility.

5. OBJECTIVES AND BENEFITS OF INFORMATION TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT

The objectives of IT in SCM are:

- Reduction of the costs of operational processes (manual work).

- Information quality enhanced by eliminating human errors.

- Rapid transfer of information between organizations

IT is key in supporting companies creating strategic advantage by enabling centralized strategic-planning with day-to-day centralized operations. Actually supply chain become more market-oriented because of IT usage. Cisco reported savings of $500 million by

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restructuring its internal operations and integrating processes with suppliers and customers with the help of web-based tools. The Wal-Mart & P&G experiences demonstrate how information sharing can be utilized for mutual advantage. Through IT, Wal-Mart shares sale information from its many retail outlet directly with P&G and other major suppliers Anderson et al (1996).

6. CHALLENGES IN IMPLEMENTING INFORMATION TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT

Any company that has undertaken the mission of implementing an integrated supply chain management strategy with the use of IT tools knows that one of the greatest challenges it faces is the significant change in internal culture that is required to make the supply chain redesign successful. It is difficult to re-condition people to accept change where a certain mindset has prevailed for many years. However it may bedifficult to accomplish, change can be successfullyimplemented when directed by a knowledgeable andstrong leader, who knows the tools available for achieving positive change, as well as their contribution in initiating and sustaining these changes. Integrating new applications with existing and legacy systems could also pose problems. Incompatible systems at buyer and vendor facilities are another management challenge to tackle. Data sharing with diverse stakeholders like suppliers and customers, filtering and mining data generated and finding "business" value of the data are other issues. Disconnected enterprise systems create data redundancy, errors and can lead to costly business inefficiencies.

Poor coordination between enterprise systems leads to flawed production plans, increased supply chain pressure and poor customer service. Lack of visibility of orders, schedules and shipments can lead to costly administrative decision making processes.

According to Macleod (1994), supply chain managers increasingly want to automate all of the supply chain, from forecasting to distribution, and to link every element of the chain. More and more companies want an integrated solution to enable them to see the entire supply chain at once. For example, they want to know that if they drill down to forecast, they can see the demand history, which is a combination of data which have come from sales order processing, inventory management and the warehousing system. Van Oldenburg (1994) says that the ability to reduce human intervention yet oversee minutely the flow of parts and products along the entire length of the supply chain can help dramatically in cutting logistics costs and boosting customer satisfaction. Unfortunately for many midsize companies in these times of economic recession, such clarity in global distribution remains largely restricted to major multinationals with deep pockets and volumes large enough to justify the hefty initial investment in IT that can run into millions of dollars.

Towill (1997) sums up "To survive, let alone win, a company must be part of one or more supply chains producing world class performance". Hence companies need to work together andoptimize the complete pipeline by establishing a seamless supply chain to maximize their market share. Only with this holistic chain concept can further significant and radical improvements in individual business performance be realized. Process manufacturers and IT system vendors are working to develop a filter to sift through the barrage of data from process control systems to move important information to higher level IT systems.

7. EXISTING INFORMATION TECHNOLOGY TOOLS AND APPLICATIONS IN SUPPLY CHAIN MANAGEMENT

Existing IT tools are as shown in the diagram below:
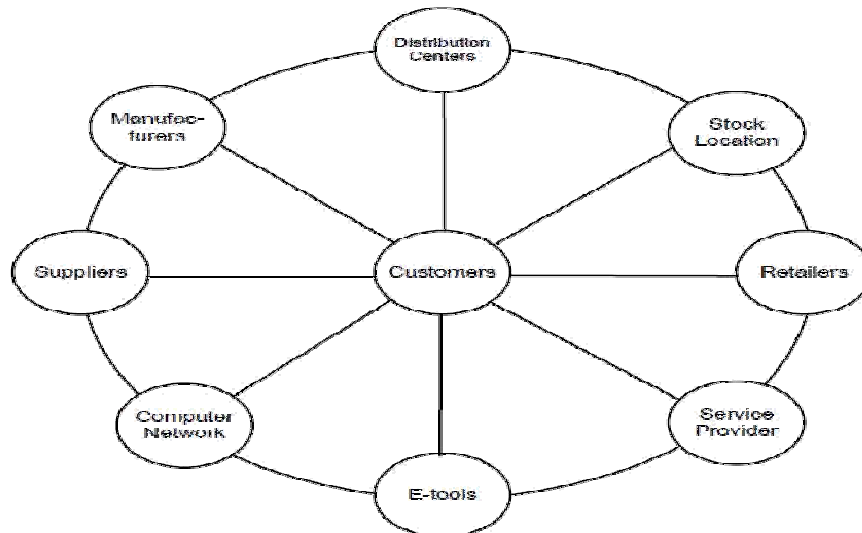
Fig 3: IT tools

7.1 Electronic Data Interchange

Introduced in the 1970s and popularized in the 1980s, Electronic Data Interchange (EDI) technology has been widely used by firms in supply chains to facilitate transactions and information exchanges. EDI is defined as computer to computer exchange of structured data for automatic processing. EDI is used by supply chain partners to exchange essential information necessary for the effective running of their businesses. These structural links are usually set up between organizations that have a long-term trading relationship.

For example, some multiple retailers will supply electronic point of sale (EPOS) data directly to suppliers, which in turn triggers replenishment of the item sold. Therefore, the consequence of this type of strong link those suppliers will be able to build a historical sales pattern that will assist their own demand forecasting activities. Because there is no need for employees to collate the information manually, EDI has many benefits, for examples, it is providing timely information about its customers' sales as well as highly accurate and very efficient. Moreover, it is utilized for sending invoices, bills of lading, confirmation of dispatch, shipping details and any information that the linked organizations choose to exchange (Rushton et al., 2000).

The main advantages of using EDI are to enter only informative needs on the computer system once, and then it is able to speed of transaction and to reduce cost and error rates. Other benefits of EDI are quick process to information, good customer service, less paper work, increased productivity, improved tracing and expediting, cost efficiency and improved billing. Through the use of EDI supply chain partners can overcome the distortions and exaggeration in supply and demand information by improving technologies to facilitate real time sharing of actual demand and supply information.

7.2 Bar coding and Scanners

Bar Codes are the representation of a number or code in a form suitable for reading by machines (Rushton et al., 2000). Bar codes are widely used throughout the supply chain to identify and track goods at all stages in the process. Bar codes are a series of different width lines that may be presented in a horizontal order, called ladder orientation, or a vertical order, called picket fence orientation. For example, goods received in a warehouse may be identified by the warehouse management system and added to stock held in the warehouse. When put away, the bar code is used to associate the storage location with the bar-coded stock, and on dispatch the stock record is amended. The use of bar codes can speed up operations significantly. On the other hand, the problems can occur if bar codes are defaced or the labels fall off in transit. The maintenance management must be applied for extending the long-life period of this equipment. Bar code scanners are most visible in the checkout counter of super markets and hyper markets. This code specifies name of product and its manufacturer.

In 1983, with barcodes printed on most goods, Wal-Mart started using checkout scanners in all its stores. They enabled headquarters to easily aggregate sales and inventory data at its centralized IT department. Later in 1987, a satellite communications network installation linked all the stores with the headquarters with real-time inventory data.

7.3 Enterprise Resource Planning (ERP) Systems

Enterprise Resource Planning (ERP) Systems are Enterprise-wide Information Systems used for automating all activities and functions of a business. These are transaction-based information systems that are integrated across the whole business. Basically, they allow for data capture for the whole business into a single computer package which gives a single source for all the key information activities of business, such as inventory, customer orders and financials.

Many companies now view ERP systems from vendors like Baan, SAP and People soft as the core of their IT infrastructure. ERP systems are enterprise-wide transaction processing tools which capture the data and reduce the manual activities and task associated with processing inventory,financial and information regarding customer order. ERP system gain a high level of integration by utilizing a single data model, developing a common understanding of what the shared data represents and establishing a set of rules for accessing data.

In addition to the huge costs that are involved in procuring an ERP application, installation of such systems will entail widespread change within the organization. It will have implications in terms of Business Process Reengineering (BPR), changes in organizational structure, people and change management. Many companies have benefited from using this system whilst some have experienced severe problems with their application. Generally, they also require a lot of customization and training for each user.

7.4 Warehouse Management Systems

Warehouse management systems are systems that control all the traditional activities of warehouse operations. Areas covered usually include receipt of goods, allocation or recording of storage locations, replenishment of picking locations, production of picking instructions or

lists, order picking, order assembly and stock rotation. Some systems are used in conjunction with radio frequency (RF) communication equipment. This equipment can be mounted on fork-lift trucks. The warehouse management system communicates with the RF system and directs the activities of the warehouse staff (Thongchattu et al, 2007). For example, when picking that it will provide the tasks for the operative to carry out. Once the task is complete the operative updates the system and is directed to the next task. This has the advantage of updating the stock holding in real time.

There are highly sophisticated systems that control the operations of fully automated warehouses. This may include automated storage and retrieval systems (AS/RS), automated guided vehicles (AGVs), and the many other devices that are relatively common in today's modern warehouse such as, conveyors, carousels, sortation systems, etc. A number of computer models have now been developed to assist in the planning of warehouse design and configuration. These are very complicated 3D simulation models that provide a graphic, moving illustration on the computer screen of the layout of the warehouse.

7.5 Transportation Management Systems

Transportation Management Systems provide more visibility into shipments and orders. Scheduling issues are also addressed on time. Multiple transportation options can be explored as a result of earlier visibility into the supply chain. Timely communication and status reports can also be obtained. By having control on its supply chain, businesses can make efficient routing decisions.

An example of such a system is developed by Target Corporation and NTE. Initially Target was making transportation requests manually for inbound shipments. There was limited visibility for shipments and as a result of this; there were more number of less-than-truckloads, which was not cost-effective. Implementation of the new system resulted in target vendors submitting the relevant freight information electronically with increased speed and efficiency. The new system resulted in improved cost controls, reduced administrative overheads and better labor planning.

7.6 Inventory Management Systems

During the mid to late 1990s, retailers began implementing modern inventory management systems, made possible by advances in computer and software technology. The systems work in a circular fashion, from purchase tracking to inventory monitoring to re-ordering and back around again.

Retailers such as Target, Lowe's and Best Buy stock tens of thousands of items from all over the world. Wal-Mart stocks items made in more than 70 countries, according to its corporate Web site. It is found that at any given time, the Arkansas-based retailer manages an average of $32 billion in inventory. With those kinds of numbers, having an efficient inventory control systemor inventory management system is imperative. System of Wal-Mart enables it maintain its signature "everyday low prices" by telling store managers which products are selling and which are taking up shelf and warehouse space.

Inventory management systems are the rule for such enterprises, but smaller vendors and businesses use them, too. The systems ascertain customers always have enough of what they

want and balance that goal against a retailer's financial need to maintain as little stock as possible. Mismanagement of inventory means disappointed customers, slower sales and too much cash tied up in warehouses. Factors like quicker production cycles, multi-national production contracts,a proliferation of products and the nature of the big-box store make them a necessity.

Modern inventory management systems must have the ability to track sales andcommunicate with suppliers in real-time, available inventory and receive and incorporate other data, such as seasonal demand. They must be flexible, allowing for a merchant's intuition. And, they must tell a storeowner how much to purchase and when it's time to reorder.

8. CONCLUSION

It is confirmed that the importance of IT and quality of information are complementary to each other because manual filtering might disappear. Although automated information processing prevents manual mistakes, it also makes the process less transparent and therefore, wrong information or information of low value might be generated if the information input is already of bad quality and not properly checked. A difference can be noticed between the volume of information and the richness of information exchange. The sharing of information in systematic language involves more action and commitments support to enhance the quality of any organization which is beneficial in the light of supply chain network. This paper discusses the role of IT as an enabler in Supply Chain Management and also highlights the vast benefits to companies with a comprehensive IT strategy. An overview and deployment of the present alignments of widely deployed IT tools like EDI, ERP, bar codes, management of inventory, and management of transportation and warehouse management systems is provided. Several successful IT implementations in SCM like Wal-Mart, Target, NASA, Best Buy, Intel etc. are described.

REFERENCES

[1] Lee HL, Padmanabhan V. The bullwhip effect in supply chains. Sloan Management Review 1997; 38(3).

[2] Chopra, Meindl. Supply ChainManagement: Strategy, planning and operation.

[3] Evans Philip B, Thomas S. Wurster: Strategy and the new economics of information. Harvard Business Review 1997; 75.

[4] Davenport Thomas H, Laurence P. Working knowledge: Howorganizations manage what they know, Boston, MA 1998.

[5] Li G. et. al.: Comparative analysis onvalue of information sharing in supply chains. Supply Chain Management: An International Journal 2005; 10.

[6] Lee, Whang. Information sharing in a supply chain. 375-381.

[7] Muntazir A. ITC's e-Choupal: Landmark in Rural Deployment, 2009. http://www.cxotoday.com/India/Case_Study/ITCs_eChoupal_Landmark_in_Rural_Deploym ent/551-99474-1004.html

[8] Anderson David L, Britt FE, Favre Donavon J. The seven principles of Supply Chain Management, Logistics Management. Supply Chain Management Review, April 1997.

[9] Auramo J, Kauremaa J, Tanskanen K. Benefits of IT in Supply Chain Management: An explorative study of progressive companies. International Journal of Physical Distribution and Logistics Management 2005; 35(2) 82.

[10] Berger A. Five steps to an eSynchronized Supply Chain, 200.0 www.accenture.com/NR/rdonlyres/18099CFB-1D5F-4FA7-BBC4-862EC465123D/0/e synchronized _supply_chain_pov_ref.pdf

[11] Haag S, Cummings M, Philips A. ManagementInformation Systems for the Information Age, McGraw HillCollege, 2006; 224-228.

[12] Harland CM. Supply chain management: relationships, chains, and networks. British Journal of Management 1996; 7: S63-S80.

[13] Lee C, Lee KC, Han JH. A Web-based Decision Support System for Logistics Decision-Making. Proceedings ofthe Academy of Information and Management Sciences 1999; 3(1).

[14] Kannabiran G, Saumen B. Corporate Turnaround through effective supply chain management: the case of a leading jewelry manufacturer in India. Supply Chain Management 2005; 10(5): 340.

[15] Rushton A, Oxley J, Croucher P. IT in the supply chain", The Handbook of Logistics and Distribution Management. Great Britain: Bell & Bain Ltd, Glasgow, 2000.

[16] True M, Izzi C. Collaborative product commerce: creating value across the enterprise. Ascet 2002; 6. Available at: www.ascet.com/documents.asp?d_ID j 981

[17] Towill D. The seamless supply chain - the predator's strategic advantage. International Journal of Technology Management 1997; 13(1): 37-56.

[18] Van Oldenborgh M. Distribution superhighway. International Business 1994; 7(6): 80-84.

[19] Gunasekharan A, Ngai EWT. Virtual Supply Chain Management. Production Planning & Control 2004; 15(6): 584-595.

[20] Ross J. Enterprise Architecture as Strategy: Creating a Foundation for Business Execution. Cambridge, Harvard BusinessSchool Press, 2006.

[21] Shore B. Information sharing in global supply chains. Journal of Global Information Technology Management 2001; 4(3): 27-46.

[22] Simchi-levi D, Kaminsky P, Simchi-levi E. Managing the Supply Chain: The Definitive Guide for the Business Professional, 2003.

[23] Macleod M. What's new in supply chain software? Purchasing & Supply Management, June 1994; 22-5.