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# IT tools for problems along the Supply Chain

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## Abstract

Businesses in the information age have to perform in real-time. There is lack of resources but loads of expectations. Traditional models thus cannot withstand the competitive times. A Supply Chain entails raw materials, suppliers, manufacturing, distribution, customers and consumers. So if a business has a strong supply chain, it is bound to perform well. Information technology has enormous potential to trigger the developments in steadying the supply chain. Present communication is an attempt to identify the problems along the supply chain and describe IT tools that can help.

## Introduction

In today's world one has to compete globally and not locally like yesteryears. World today has become so nimble that it is continuously changing and becoming more complex and competitive. Businesses in the information age must accept these changes and be ready to be more competitive and customer-focused. There is a global competition for labor and trade and operations are now supposed to be performed in real-time. Customers are demanding detailed information about products and services. Companies are facing problems in producing superior products in less resources and information is becoming critical for management decision-making. The answer to all these problems lies in using information technology effectively and intelligently. Information technology has come up in facilitating companies to respond to this problem efficiently. There is no dearth of high performance telecommunication technologies that can perform real time operations, computer-integrated manufacturing and efficient management of information. Advances in the use of Internet and electronic commerce can do miracles to the good of businesses.

Owing to these pressures many companies are now planning to reap the benefits of alliances with other companies. Supply Chain Management (SCM) is responsible for looking after such alliances and it

seeks to make every step in the chain as efficient as possible by ensuring good coordination between the alliances. SCM is therefore dependent on computer-based communication technologies.

### Supply Chain Problems

A Supply Chain entails raw materials, suppliers, manufacturing, distribution, customers and consumers. Material from supplier to customer moves on in the supply chain and it is believed that a smooth flow of these materials only depicts the health of the supply chain. However in reality a supply chain entails movement from and to many warehouses. There are many steps involved, many inventories involved and lot of time consumed. SCM is actually so big that it can be difficult to exemplify each and every component of it. In bigger connotation, the function of supply chain is to plan, organize, coordinate and control almost all the activities of the company.

There are a lot of uncertainties encompassing a supply chain. Also, a supply chain continuously

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pursues to coordinate its activities, units and alliances. These two factors are the main source of problems in SC. Some of the supply chain uncertainties are demand forecast, delivery times, and quality problems with material. Some of the coordination problems are lack of connectedness between departments, mis-information, and lack of information or late information. Following are the problems along the supply chain:

- *Poor customer service* : If customer does not get what he requires at an appropriate time or if he receives poor quality products.
- *High inventory costs* : If a company has high inventory costs and no synchronization between stocks and demand, its product are bound to have higher costs and thus put that business in a bad position.

- *Loss of revenues* : If company has too many non value-added activities.
- *Extra cost of expediting shipments* : If customer orders are not shipped on time or shipped using costly means, customers would be unhappy and may not remain faithful.
- *Bullwhip effect* : If a company has erratic shifts in orders (Bullwhip Effect) along the supply chain, it is bound to face production and inventory problems.
- *Phantom stock outs* : If a customer is told that product is out of stock while in reality it is available.

Effective solution to these problems is a must for the company to survive. It is capable of providing solutions to these problems. Turban et al. (2004) gave some examples of how Information Technology (IT) can solve recurrent supply chain problems.

| IT Tools                               | Supply Chain Problem  |
|--|---|
| Artificial neural networks             | Need is there to derive meaning from complicated or imprecise data. ANNs replaces the need to manually build complex formulas. It can also be used to complete complex logistical challenges such as truck routing. |
| Electronic Data Interchange (EDI)      | Slow delivery of paper documents.   |
| Electronic document management systems | Repeat process activities due to wrong shipments, poor quality etc., Accumulated work orders between supply chain processes.  |
| Genetic Algorithms                     | Need for inventory optimization, scheduling problems etc.   |
| Groupware                              | Waiting times between chain segments is excessive, Poor coordination, cooperation, and communication, Decline in the value of parts and components that stay too long in storage.                                   |
| Intelligent Systems                    | Learn about delays after they occur, or learn too late.   |
| Internet and Internet 2                | Lack of information, or too slow flow, Redundancies in the supply chain. Too many purchasing orders, too much handling and packaging.   |
| Intranets and Extranets                | Waiting times between chain segments is excessive, Lack of information, or too slow flow, Obsolescence of parts and components that stay too long in storage.   |
| JIT systems                            | Too much of inventory costs and poor workflow due to improper scheduling of materials.  |
| Robotics                               | Delays in shipments from warehouses.  |

Table 1: IT tools for Supply Chain problems

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## Information Technology (IT) Tools

As mentioned in the table 1, there is plethora of tools that can strengthen the supply chain of an organization. These tools are discussed in brief:

Artificial neural networks : Artificial neural networks are electrical analogues of the biological neural nets. The most common application of neural network is in the field of machine learning. One can find many applications of neural networks in control, automation, robotics, computer vision, scheduling, knowledge acquisition and planning. They are useful in many applications because they derive meaning from complicated or imprecise data. These situations are otherwise complex and undetectable by humans and other computer techniques. Neural Networks are good at identifying patterns or trends in data and hence they are well suited for prediction and forecasting needs. One of the major uses of neural networks is in path planning of the mobile robots. Mobile robots works on sensors that help them recognize the world as the humans do. Neural Network based navigational model has been applied for online navigation of such robots. They help the robot to receive sensory information, generate control commands for motion and direction and finally set the schedule of motions. They are also used for acquisition of knowledge in an expert system. Fuzzy neural networks are applied for automated estimation of certainty factors of knowledge from proven and historical databases of a typical reasoning system.

Electronic Data Interchange (EDI) : As the name suggests EDI is the electronic transmission of business documents like purchase orders, invoices, approvals, notices and confirmations directly between computer systems of companies doing business with each other. Previously, EDI used to run on value-added networks (VANs), which were too costly for small businesses to implement. However, now Internet-based EDI are available which are virtually free.

Electronic document management systems : Electronic document management systems converts paper based documents to digital electronic form via scanning and related technologies like barcodes, optical mark readers (OMR) and optical character readers (OCR). They are basically storage crunchers. They

organize the documents and make them available for any changes.

Genetic Algorithms : Genetic algorithms are stochastic algorithms. They were first proposed by Holland in 1975. They are based on the natural process of biological evolution. These methods follow the "Survival of the fittest" principle of Darwin. They are called "genetic" because they work on the same principles as genetics: The members, which adapt well to the environment, are selected for reproduction and produce offspring. Poor performers die without offspring. Genetic algorithms have been used in intelligent search problems. These problems include games, routing problems in VLSI circuits and navigational planning of robots. Genetic algorithms have been used in many optimization problems like the traveling salesman problem and the job shop scheduling problems etc.

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Groupware : Groupware also facilitates collaboration among people. It is a class of software products. There are many workgroups within a company who often interact with each other and share information. This coordination is facilitated by groupware. Evolution of groupware was a result of growth in the decision support systems. It started with Executive information systems (EIS) that were designed to support senior executives. A need was also felt for supporting people in groups. Group Support Systems (GSSs) emerged to support people working in decision-making situations in a single location. Due to advances in network computing GSS was able to support people working at different locations and thus groupware emerged. The major benefits obtained by using groupware are effective project management, location independence, increased communications, increased information availability and improved workflow. An example of groupware is IBM'S Lotus Notes/ Domino. It is a document management system, a distributed client/server database and a basis for

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intranet and electronic commerce system. Group members can share, access, interchange or update any information that is of value to them. Microsoft's Exchange is also an example of an electronic messaging server that incorporates groupware functionality for sharing information. Other groupware products are Oracle's Interoffice, Novell's GroupWise and Netscape's Suite Spot Servers.

***Intelligent Systems***: Intelligent systems use artificial intelligence to perform complex tasks. They have enhanced capabilities like learning from experience, making sense of ambiguous messages, responding quickly to alien situations and using reasoning to solve problems.

***Internet and Internet 2***: Internet is a network of networks. It is a collection of many thousands of computers linked together. These linked computers share and exchange information flawlessly. Internet allowed people to communicate in real time. It has democratized the information. The number of computers and networks connected to the Internet is growing rapidly. Internet 2 evolved due to the need of academic research community for data-intensive applications. Internet 2 has over 180 universities around the world working in partnership with industry and government to develop advanced network applications and technologies. Internet 2 is a network of high bandwidth networks on the Internet. Efforts are also on to build an even faster, natural, intelligent and easy Internet. The nomenclature given to this new Internet is Next Generation Internet (NGI).

***Intranets and Extranets***: Intranets are networks within a business that use Internet technologies to link corporate communications. Intranet is basically a private Internet. It is limited to be used by only those users that have authority to use that network. Companies use intranets for sharing corporate information among its employees. One might recall that many universities abroad are using these intranets to deliver lecture notes, quizzes and assignments etc. When one reaches that page, the GUI client of the web browser asks for a login and password. One can enter only when one is a valid user. Many applications like leave records, corporate policies and procedures, information sharing, telephone directories, customer databases, product information and catalogues etc. are possible on the

corporate intranets. Extranets are secured networks that connect the intranets of several business partners. Extranets enable persons outside the company to work in collaboration with the internal employees of the company. The term extranet comes from "extended intranet". The extranets are aimed at providing a platform for collaboration between suppliers, customers and other business partners. Extranets can be accessed through Internet. An extranet uses servers, TCP/IP protocols, e-mail, web browsers and virtual private network (VPN) technology. It is far less costly than proprietary networks.

***JIT systems***: JIT inventory approach is an effort to reduce costs and improve workflow by scheduling materials and parts to arrive at a time when they are actually needed. JIT minimizes in-process inventories and waste. Today large and complex JIT systems can be employed with the help of information technology.

***Robotics***: Robotics generally refers to a broad category of systems that perform sensory activities with the help of artificial intelligence. A robot is an electro-mechanical device that can be programmed to automate manual tasks. Today robots are used in activities like welding, painting, cleaning and material handling etc. They are also successfully employed in assembly lines. Robots are used in e-commerce warehouses for finding, moving and packing items in hazardous environments.

## **E-Commerce**

E-commerce started with EDI and is about buying and selling. Internet-based e-commerce relies on the development of the Internet as a communication medium. It is the development of www that has made e-commerce possible. The first success story in e-commerce is attributed to the virtual bookstore [www.amazon.com](http://www.amazon.com). There are many e-commerce companies like amazon.com that are valued at millions of dollars. There are many categories of e-commerce by transaction e.g. business to business (B2B), business to consumer (B2C), business to government (B2G) or consumer to consumer (C2C) etc. There are many benefits that e-commerce can offer:

- It benefits the supplier as they can have global presence and the customers as they can have

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global choice.

- It benefits suppliers by improving competitiveness and customers by improving the quality of service
- It gives opportunity of mass customization to the supplier and opportunity of personalized product to the customer
- It minimizes the supply chains and hence gives customer a quick response
- It substantially reduces the cost incurred by the supplier and hence under prices the final price for the customer
- It generates novel business opportunities for the supplier and new services for the customer.

Presently, there are many companies which not only use e-commerce for buying and selling but also for the ways in which they stock and supply goods. Large warehouses with big supplies are becoming redundant and small warehouses with more frequent deliveries are in vogue. Online environment has made it possible to minimize handling, respond quickly and minimize resources and still remain competitive. There are many examples of sites offering online auctions (<http://www.ebay.in/>), online machinery auction site ([www.auctionindia.com](http://www.auctionindia.com)); third party customer response ([www.tcil.com](http://www.tcil.com)); online flower shop ([www.phoolwala.com](http://www.phoolwala.com)) and online dealers community of Asia's biggest IT Market ([www.npithub.com](http://www.npithub.com)) etc.

### **Recent Examples of use of IT in supply chain management**

There is lot of time and efforts being devoted to generate newer models for supply chain management by using the advances in the information technology (IT). We mention a few such examples to get a glimpse of the stance, which supply chain management, would take together with IT.

Nagurney et.al (2005) developed a supply chain network model in which both physical and electronic transactions are allowed and in which supply side risk as well as demand side risk are included in the formulation. The model consists of three tiers of

decision-makers: the manufacturers, the distributors, and the retailers, with the demands associated with the retail outlets being random. The optimizing behavior of the various decision-makers was, with the manufacturers and the distributors being multi-criteria decision-makers and concerned with both profit maximization and risk minimization. This is the first multi-tiered supply chain network equilibrium model with electronic commerce and supply side and demand side risk.

Piramuthu (2005) developed a framework, with machine learning, for automated supply chain configuration. Once a supply chain is configured, researchers and practitioners were more interested in means to improve performance given that initial configuration. However, recent developments in e-commerce applications and faster communication over the Internet in general necessitates dynamic (re) configuration of supply chains over time to take advantage of better configurations. Piramuthu (2005) showed performance improvements of the adaptive supply chain configuration framework over static configurations.

Hill and Scudder (2002) used the data from a survey of the food industry to examine the use of EDI in SCM. They found that companies would use EDI to become more coordinated with suppliers, but not necessarily with their customers. However their results indicated that firms view EDI as a tool for improving efficiencies rather than as a tool for facilitating supply chain integration.

Lancioni et. al (2000) conducted a survey to determine to what extent U.S. firms have been using the Internet in the operation and management of their supply chains. The research revealed that Internet is used in SCM in transportation, order processing, managing vendor relations, purchasing, procurement, and customer service etc. They commented, "The Internet has and will continue to provide logistics managers with this information and enable them to improve the profitability of their supply chains".

Xiang-Yang et. al (2005) applied support vector machine (SVM) concept in supply chain management to propose a model of collaborative identification of coordination questions in supply chain, which ensure the competitive advantage by integrating

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the resources. SVM is one of the intelligent technologies in the machine-learning domain.

Li Xiaohong et. al (2005) commented, " At present, the study on supply chain management system based on mobile agent is extensively developed around world". They laid emphasis on a framework of the negotiation agent system of supply chain.

Montana et. al (1998) used genetic algorithms to solve complex scheduling problems in areas like field service scheduling, air crew scheduling, and transportation scheduling.

These examples are only indicative of the rapid strides made by IT in supply chain management.

### Conclusion

Businesses in the information age must accept the global changes and be ready to be more competitive and customer-focused. There is no dearth of high performance telecommunication technologies that can perform real time operations, computer-integrated manufacturing and efficient management of information. Advances in the use of Internet and electronic commerce can do miracles to the good of businesses. A supply chain continuously pursues to coordinate its activities, units and alliances. IT can help in solving such problems. Many big companies are giving high importance to software integration. There are many companies which not only use e-commerce for buying and selling but also for the ways in which they stock and supply goods. In a nutshell, all these tools are of great value in the effective management of supply chain.

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