UNIT 8 INFORMATION TECHNOLOGY: A KEY ENABLER OF SCM

Objectives

After reading this unit you would be able to:

- recognize the importance of Information in Integrated Supply Chain Management;
- discuss the categories of information and their role in Inter organizational setup;
- describe the methods of determining the information requirements for a supply chain; and
- be familiar with the Information Technology and their applications in Supply Chain Management for increasing efficiency.

Structure

8.1 Introduction
8.2 Information and Technology in the Integrated Supply Chain
8.3 Importance of Information in Integrated Business
8.4 Inter Organizational Information Systems (IOIS)
8.5 Information Requirements Determination for a Supply Chain
8.6 Information and Technology Applications for SCM
8.7 Summary
8.8 Self Assessment Questions
8.9 References and Suggested Further Readings

8.1 INTRODUCTION

To survive, thrive and beat the competition in today's brutally competitive world, one has to manage the future. Managing the future means managing information. In order to deliver quality information to the decision-maker at the right time and in order to automate the process of data collection, collation and refinement, organizations have to make Information Technology an ally, harness its full potential and use it in the best possible way.

Information technology is revolutionizing the way, in which we live and work. It is changing all aspects of our life style. The digital revolution has given mankind the ability to treat information with mathematical precision, to transmit it with high accuracy and to manipulate it at will. These capabilities are bringing into being, a whole world within and around the physical world. The amount of calculation power that is available to mankind is increasing at an exceptional rate. Computers and communication are becoming integral parts of our lives.

IT has a major role to play in any organization. All organizations have certain objectives and goals to achieve. For any organization to succeed, all business units should work towards this common goal. But each department or business function in the organization will have its own goals and procedures. The success of an organization rests in resolving the conflicts between the various business functions and making them do what is good for the organization as a whole. For this, information is critical. Everybody should know what is happening in other parts of the organization.

IT has a major role to play both at the organizational level and at the departmental level. At the organizational level, IT should assist in specifying the objectives and strategies of the organization. IT should also aid in developing and supporting, and procedures to achieve them. At the departmental level, IT must ensure a smooth flow of information across departments, and should guide organization to adopt the most viable business practices. At this level, IT ensures seamless flow of information across the different departments and develops and maintains an enterprise – wide database. This database will eliminate the need of the isolated data islands that existed and in each department and make the organization's data accessible across the departmental boundaries. This enterprise– wide sharing has many benefits likes automation of procedures, availability of high quality information for better decision-making and faster response times.

In this unit, we will learn the importance of the information required for effective supply chain management and a number of information technologies and the application of the information that organizations are using to make information readily available across the supply chain.

8.2 INFORMATION AND TECHNOLOGY IN THE INTEGRATED SUPPLY CHAIN

As discussed in the earlier Blocks, the supply chain management is concerned with the flow of products and information between the supply chain members that encompasses all of those organizations such as suppliers, producers, service providers and customers (See Figure 8.1). These organizations linked together to acquire, purchase, convert/manufacture, assemble, and distribute goods and services, from suppliers to the ultimate and users.

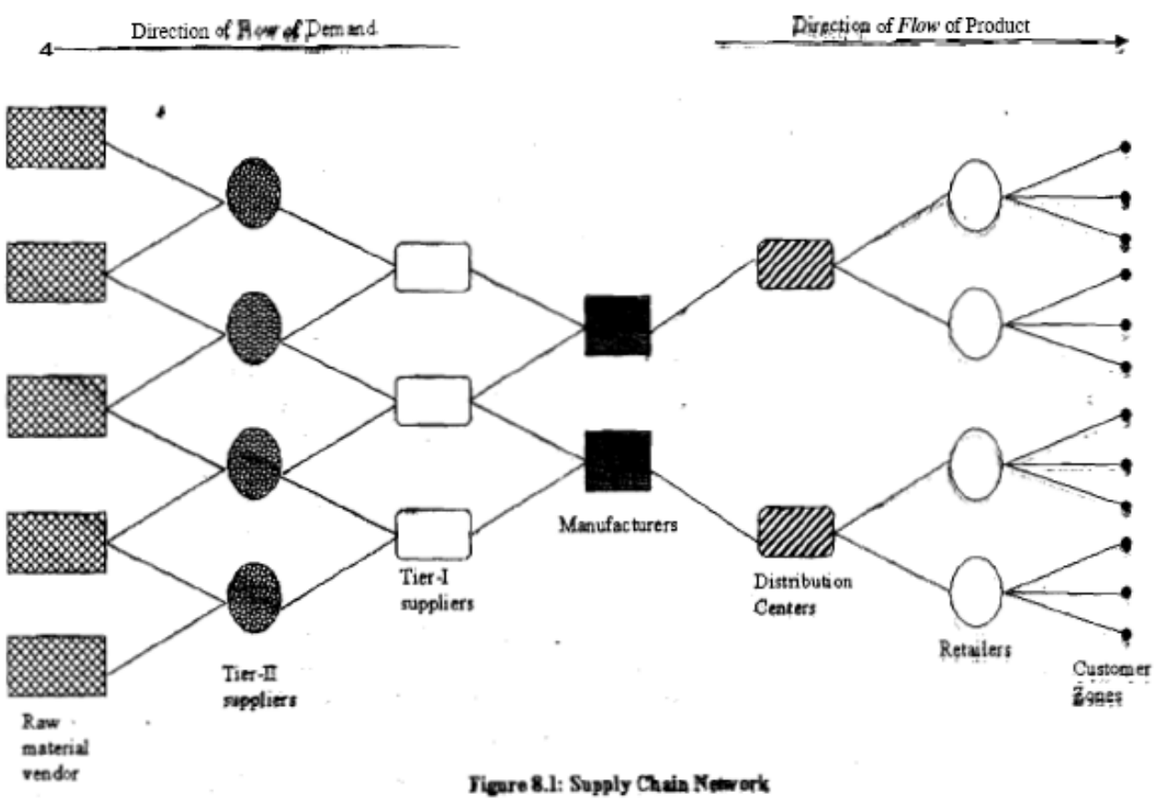

Figure 8.1: Supply Chain Network

By 1980, the information revolution was well accepted in the world's advanced economics. During this period, many standard business processes and functions such as customer order processing, inventory management, and purchasing were altered through the use of computer technology. These technologies and capabilities began to grow exponentially since 1985, providing means for multiple organizations to coordinate their activities in an effort to truly manage a supply chain.

Today, information and technology must be conceived of broadly to encompass the information that businesses create and use as well as a wide spectrum of increasingly convergent and linked technologies that process the information with the emergence of the personal computer, optical fiber networks, the explosion of the Internet and the world wide web. The cost and availability of information resources allow easy linkages and eliminate information-related time delays in any supply chain network. This means that organizations are moving toward a concept known as Electronic Commerce, where transactions are completed via a variety of electronic media, including electronic data interchange (EDI), electronic funds transfer (EFT), bar codes, fax, automated voice mail, CD-ROM catalogs, and a variety of others. The old "paper" type transactions are becoming increasingly obsolete. Leading-edge organizations no longer require paper purchase requisitions; purchase orders, invoices, receiving forms, and manual accounts payable "matching" process. All required information is recorded electronically, and associated transactions are performed with the minimum amount of human intervention. Recent developments in database structures allowed part numbers to be accumulated, coded, and stored in databases, and electronically ordered. With the application of the appropriate information systems, the need to constantly monitor inventory levels, place orders, and expedite orders will soon become a thing of the past.

8.3 IMPORTANCE OF INFORMATION IN INTEGRATED BUSINESS

Information is the key to the decision making in Business. Prior to the 1980s, a significant portion of the information used to flow between functional areas within an organization, and between supply chain member organizations, were paper-based. In many instances, these paper-based transactions and communications were slow, unreliable, and error prone. Conducting business in this manner was costly because it decreased firms' effectiveness in being able to design, develop, procure, manufacture, and distribute their products. During this period, information was often overlooked as a critical competitive resource because its value to supply chain members was not clearly understood. However, firms that are embarking upon supply chain management initiatives now recognize the vital importance of information and the technologies that make this information available.

In a sense, the information systems and the technologies utilized in the supply chain represent one of the fundamental elements that link the organizations into a unified and coordinated system. In the current competitive climate, little doubt remains about the importance of information and information technology to the ultimate success, and perhaps even the survival, of any supply chain management initiative. Cycle time reduction, implementing redesigned cross-functional processes, utilizing cross-selling opportunities and capturing the channel to the customer *underpin* the competitive positioning of business.

Timely and accurate information is more critical now than at anytime. Three factors have strongly impacted this change in the importance of information.

1) Satisfying, in fact pleasing, customers have become something of a corporate obsession. Serving the customer in the best, most efficient, and effective manner has become critical, and information about issues such as order status, product availability, delivery schedules, and invoices has become a necessary part of the total customer service experience.

2) Information is a crucial factor in the managers' abilities to reduce inventory and human resources requirements to a competitive level.

3) Information flows play an essential role in the strategic planning for and deployment of resources.

The need for virtually seamless bonds within and between organizations is a key notion in the essential nature of information systems in the development and maintenance of successful supply chain. That is, creating inter-organizational processes and link to facilitate delivery of seamless information between marketing, sales, purchasing, finance, manufacturing, distribution and transportation internally, as well as inter organizationally, to customers, suppliers, carriers, and retailers across the supply chain will improve fill rates of the customers service, increase forecast accuracy, reduction in the total inventory and savings in the company's' transportation costs - goals which need to be achieved.

Clearly, the need to share information across the supply chain is of paramount importance. In fact, inaccurate or distorted information from one end of a supply chain to the other can lead to tremendous inefficiencies such as excessive inventory investment, poor customer service, lost revenues, misguided capacity plans, ineffective transportation, and missed production schedules. This is termed to be bullwhip effect, which is commonly being experienced by the consumer goods industries. Suitable technologies such as bar codes and scanners have been developed and applied in the portions of supply chain and remove inaccurate or distorted information.

Activity 1

Develop procedures to elicit and define information needs for making a decision for an organization of your choice. How would you implement your plan? What are the problems?

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8.4 INTER ORGANIZATIONAL INFORMATION SYSTEM

In supply chain management, the suppliers, producers, retailers, customers, and service providers are the members and are linked through the ultimate level of integration. These members are continuously supplied with information in real time. The foundation of the ability to share information is the effective use of Information Technology within the supply chain. Appropriate application of these technologies provides decision makers with timely access to all required information from any location within the supply chain. Recognizing the critical importance of information in an integrated supply chain environment, many organizations are implementing some form of an inter-organizational information

system (IOIS). IOISs are the systems based on information technologies that cross organization boundaries.

An IOIS is an integrated data-processing/data-communication system utilized by two or more separate organizations. These organizations may (buyer-supplier) or may not (credit clearing house) have a preexisting business relationship. What must exist is a computer-based electronic link between the two organizations that automates some element of work, such as order processing, order-status checking, inventory-level review, shipment tracking information or, minimally, transaction transfer, which would previously have been performed manually or through other media, such as the mail.

Among the earliest forms of IOISs were those developed by time-sharing services and on-line database vendors. The potential impact of such systems on the way business is conducted was recognized as early as the 1960s. Since that time, new technologies have been integrated to produce systems of increasing capability. Examples of such implementations include electronic funds transfer (EFT) systems, the Treasury Department's decision support system, a variety of buyer-supplier order-processing systems, and on-line professional tool support systems. Existing implementations serve the grocery industry, the drug wholesaling industry, the insurance industry, and the transportation industry, with more systems coming into existence each year.

The development of an IOIS for the supply chain has three distinct advantages: cost reductions, productivity improvements, and product/market strategy. Five basic levels of participation for individual firms within inter organizational system are:

1) Remote I/O node, in which the member participates from a remote location within the application system supported by one or more higher-level participants;
2) Application processing node, in which the member develops and shares a single application such as an inventory-query or order-processing systems;
3) Multi participant exchange node, in which the member develops and shares a network inter-linking itself and any number of lower-level participants with whom it has an established business relationship;
4) Network control node, in which the member develops and shares a network with diverse applications that may be used by many different types of lower-level participants; and finally
5) Integrating network node, in which the member literally becomes a data-communications/data-processing utility that integrates any number of lower-level participants and applications in real time.

The participant shares a network of diverse applications with any number of participants with whom it has an established business relationship. IOIS participants may therefore be at a level lower, higher, or equal to the IOIS sharing organizations. As organizations explore development of IOISs to support their supply chain management efforts, they will be faced with several challenges. Developing a common language in terms of planning, format, and priority across several vastly different constituencies. Information sharing requirements are well beyond those of a manufacturer, and its distributor's need to process orders in a consistent way. All relevant information ultimately must circulate to and among all organizations between the supply chain's point of origin and its point of consumption, such as ordering (i.e., orders for component parts, services, and finished products), inbound transportation, manufacturing, warehousing, inventory management, outbound transportation, sales, marketing, forecasts, and customer-service information. Although organizations recognize the importance of an IOIS

for effective supply chain management, no one standard approach is being utilized in terms of technology or information.

Activity 2

Consider your organization or an organization with which you can freely access for information. What are the most frequent indicators for evaluating the performance of lower, middle, and top managers in the considered organization? Compare these indicators with that of another organization.

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8.5 INFORMATION REQUIREMENTS DETERMINATION FOR A SUPPLY CHAIN

It is important to ensure that the right information are captured and used to manage the supply chains effectively (doing right things) and efficiently (doing these things well). Four fundamental mistakes are commonly made when determining information requirements and these are:

1) Viewing systems as functional instead of cross-functional
2) Interviewing managers individually instead of jointly
3) Not allowing for trial and error in the detail design process
4) Asking the wrong questions during the interview.

Viewing systems as functional instead of cross functional is a very narrow and inappropriate perspective to take in the information requirements determination process. Much of the information needed to make decisions within a given function will come from sources outside the function. Therefore, it is necessary to include all of the functions involved in an information system in order to facilitate the development of the system that allows information to flow cross-functionally. When developing information systems to support an integrated supply chain, this cross-functional perspective needs to be extended to be cross-functional and inter-organizational, because the information required to make decisions within one organization may come from another supply chain member.

To properly determine information requirements across organizations, it is important to use appropriate method that ensure all information requirements are identified. Therefore, a cross-organizational session using several structural-interviewing techniques, including business systems planning, critical success factors, and ends/means analysis are suggested for this purpose.

1) **Business Systems Planning (BSP)** is a structured interview technique developed by IBM. It focusses on the identification of problems and decisions associated with an organizational process and determine what information is needed to address them. For a supply chain management, analysts must identify supply chain management problems and decisions for the member organizations. The result of this process is a set of tables listing the problems that must be addressed, the decisions that must be made across

the supply chain, and the information required to address them. Tables 8.1 and 8.2 present Business Systems Planning examples.

Table 8.1: BSP–Problems/Solutions/Information

Problems	Solutions	Information
• Reduce order fulfillment cycle times between supply chain member organizations while maintaining or reducing total supply chain logistics cost.	• Need to understand current order fulfillment performance between supply chain members and logistics cost/performance trade-offs across the supply chain.	• Order fulfillment performance for each organization • Total supply chain logistics cost • Order history between supply chain members • Inventory carrying cost per item for each organization • Transportation cost and lead times by different modes and carriers.

Table 8.2 : BSP–Decisions/Information

Decisions	Information
• How to transport product X	• Carrier and mode used by competition • Transportation cost and performance by mode and carriers.

2) **Critical Success Factors (CSF)** focus on key performance areas that must function effectively for the organization to be successful and associated information requirements. For the supply chain, CSFs have to be identified for each of the member organizations. As one might imagine, most of the organizations have common CSFs. Once the CSFs are determined, the information needed to address the CSFs is then identified. Table 8.3 presents critical success factors (CSF) example.

Table 8.3 : CSF–CSF/Information

Critical Success Factors	Information
• Integrated supply chain performance measurement system	• Performance measures for integrated supply chain. • Performance measures for individual member organization. • Actual performance for supply chain and organizational measures. • Targets/goals for measures. • Historical performance for measures.

3) **Ends/Means (E/M) analysis** focuses on what it takes for an organization to be both effective (doing the 'right' things) and efficient (doing these things well) and on the information needed to manage it. This interview technique consists of two phases. First, the analyst identifies the *ends* that the supply chain members consider important, the effectiveness issues associated with the ends, and the information needed to address them. The second phase deals with means, their associated efficiency issues, and the information needed to address them. Table 8.4 and 8.5 present Ends and Means analysis examples, respectively.

Table 8.4 : Ends/Means Analysis – Ends/Effectiveness/Information

Ends	Effectiveness	Information
• Reduce order-fulfillment cycle times across the supply chain in a way that improves customer satisfaction.	• Minimize total supply chain logistics cost • Activity-based cost accounting information • Maximize profit	• Customer preferences (features, cost, time) • Profit by supply chain member organization • Supply chain performance (order fulfillment cycle time, inventory levels, capacity, customer satisfaction).

Table 8.5 : Ends/Means Analysis – Means/Efficiency/Information

Means	Efficiency	Information
• Monitor inventory performance: - Total supply chain inventory levels (days, Rs.) - Organization inventory levels (days, Rs.) - Turns - Service levels - Costs.	• Minimize cost required to measure inventory performance	• Actual cost for measuring each factor

The result of each of the structured interview techniques is a set of tables that identifies areas of concerns across the organizations and the associated information needed to address these concerns. There will be some redundancy in the information requirements identified when using multiple structured interview techniques. This helps to ensure that the analyst has a comprehensive and accurate set of information requirements.

Traditional systems development also does not allow for trial and error when designing information systems. The outcome of this approach to systems development has resulted in systems that need to be changed the day they are implemented and, in a worst-case serve as systems that are totally unusable. Prototyping was introduced as a way to overcome these problems by validating systems requirements through experimenting, refining, and testing the system until the development team and users are satisfied that they have identified all of the information requirements for the system being developed. The specific information identified for the supply chain consists of ten primary categories. These categories and examples of information contained within them are shown in Table 8.6.

Table 8.6 : Supply Chain Information Categories

Information Categories	Examples of Information contained in Categories
1. Production information	Product specifications, price/cost, product sales history
2. Customer information	Customer forecasts, customer sales history, management team
3. Supplier information	Product line, product lead times, sales term & conditions.
4. Production Process information	Capacities, Commitments, production plans.
5. Transportation information	Carriers, lead times, cost
6. Inventory information	Inventory levels, inventory-carrying costs, inventory locations.
7. Supply chain alliance information	Key contacts for each organization, partner roles and responsibilities, meeting schedules.
8. Competitive information	Benchmarking information, competitive product offering, market share information.
9. Sales and marketing information	Point of-sale information, promotional plans.
10.Supply chain process and performance information	Process descriptions, performance measures, cost, quality, delivery, time, customers' satisfaction, etc.

Activity 3

Select a typical manufacturing organization and describe the dependencies that exist among the departments. Prepare a dependency chart showing information and material flows.

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8.6 INFORMATION AND TECHNOLOGY APPLICATIONS FOR SCM

Many innovations on technology-based approaches are well suited to the enhancement of supply chain management, including Just-in-Time, Quick Response, Efficient Consumer Response, and Continuous Replenishment – all rely heavily on the information made available through the latest technological advances. In the development and maintenance of the supply chain's information systems, both hardware and software must be addressed. Hardware includes computers, input/output devices, and storage media. Software includes all of the system and application programs used for processing transactions, management control, decision-making, and strategic planning. A few examples of software titles that address some aspect of supply chain management are presented below:

1) Base Rate, Carrier Select, and Match Pay (Version 2.0) developed by Distribution Sciences, Inc., with which users can compute freight costs, compare transportation mode rates, analyze cost and service effectiveness of carriers, and audit and pay freight bills;

2) A new software program developed by Ross Systems, Inc., called Supply Chain Planning is an integrated suite of constraint-based planning tools that provide demand, replenishment, and manufacturing tools for accurate planning and scheduling of those activities. This software provides an end-to-end enterprise-resource planning solution incorporating the most advanced supply chain planning capabilities available.

3) A technology partnership between Procter & Gamble Distributing Co. and Sabre Decision Technologies resulted in a software system called Transportation Network optimization, which allows shippers to give bidding, in twin streamlining the bidding and award process.

4) Logistility Planning Solutions was recently introduced to provide a program capable of managing the entire supply chain from demand to supply by synchronizing customer demand and supply constraints through the provision of Internet enabled communications about forecasts, inventory, and replenishments for all members of the chain.

Several technologies have gained popularity recently, due to their ability to facilitate the flow of information across the supply chain. Electronic commerce, Electronic Data Interchange, Bar coding and Scanning, Data Warehouse, Internet, Intranet/Extranet, World wide Web, Decision Support systems are a relatively

recent phenomenon for supply chain management applications. These are discussed in the following sections.

Electronic Commerce

Electronic Commerce is the term used to describe the wide range of tools and techniques utilized to conduct business in a paperless environment. Electronic commerce therefore includes electronic data interchange (EDI), e-mail, electronic founds transfers, electronic publishing, image processing, electronic bulletin boards, shared databases, and magnetic/optical data capture (such as bar coding), the Internet, and Web sites. Electronic commerce is having a significant effect on how organizations conduct business. Companies are able to automate the process of moving documents electronically between suppliers and customers in such a manner that the entire process is handled electronically; no paperwork is involved. With the rise of the Internet and the ability to transfer information cheaply and effectively over the whole world, electronic commerce is becoming a major focus for many organizations and represents a significant opportunity for integrated supply chain management efforts.

Electronic Data Interchange

Electronic data interchange, commonly referred to “EDI”, is the computer to computer interchange of business documents and/or information between trading partners in standard data format. Where, trading partners means, cooperation between companies is required to get the EDI systems running properly. Computer-to-computer and standard data format mean information must be precisely formated so that a computer can process the information without human assistance. EDI replaces the traditional forms of mail, courier, or fax. It is being utilized to link supply chain members together in terms of order processing, production, inventory, accounting, and transportation. It allows members of the supply chain to reduce paperworks and share information on invoices, orders, payments, inquiries, and scheduling among all channel members. The benefits of EDI are numerous: quick access to information, better customer service, reduced paperwork, better communications, increased productivity, improved tracing and expediting, cost efficiency, competitive advantage, and improved billing.

EDI improves productivity through faster information transmission as well as reduced information entry redundancy. Accuracy is improved by reducing the number of times an individual is involved in data entry. The use of EDI results in reduced costs on several levels, including:

1) Reduced labour and material cost associated with printing, mailing, and handling paper-based transactions;
2) Reduced telephone and fax transmissions; and
3) Reduced clerical costs.

EDI is also tremendously beneficial in counteracting the bull whip effect described earlier in this unit. Through the use of EDI, supply chain partners can overcome the distortions and exaggerations in supply and demand information by using technology to facilitate real-time sharing of actual demand and supply information. Although about 20 percent of all retailer orders for consumer products were placed via EDI in 1990, that percentage had grown to well over 60 percent by the end of 1995. Clearly, firms are realizing that the use of EDI to facilitate information sharing throughout the supply chain is beneficial.

In general, EDI is used for communication of business information such as purchase orders, invoices, bills of lading, shipping instructions, production sequences, inventory or order status, fund remittances, and point-of-sale information (in the case of retailers).

EDI cuts down time delays, labor costs, errors, inventory and uncertainty. Business with EDI reduces the paper work, which is about 4 to 7% of the value of the goods traded. The EDI activities are the following:

1) Sales return could be analyzed and fed into the ordering process;
2) Orders could be raised to reflect both demand and known stock availability;
3) Instruction could be sent to distributors in parallel with the orders to ensure fast delivery;
4) Carriage by road, rail, sea, or air could be booked simultaneously;
5) Customs clearance documents could be available in advance of goods arriving, avoiding hold ups;
6) Payment instructions could be issued to banks to ensure prompt payment.

Bar Coding and Scanning

At its most basic level, bar coding refers to the placement of computer readable codes on items, cartons, containers, and even railcars. This particular technology application drastically influenced the flows of product and information within the supply chain. As noted throughout this unit, information exchange is critical to the success of supply chain management. In the past, this exchange was conducted manually, with error-prone and time-consuming paper-based procedures. Bar coding and electronic scanning are identification technologies that facilitate information collection and exchange, allowing supply chain members to track and communicate movement details quickly with a greatly reduced probability of error. The critical point-of-sale data that organizations such as Wal-Mart provide to their supply chain partners is made possible through the use of bar coding and scanning technology. This same technology is critical to transportation companies, such as FedEx, by enabling them to provide their customers with detailed tracking information in a matter of seconds.

Bar code scanners are most visible in the checkout counters of the supermarket. They scan the black-and-white bars of the Universal Product Code (UPC). This code specifies the name of the product and its manufacturer. Bar codes are used in hundreds of situations, ranging from airline stickers on luggage to blood samples in laboratories. They are especially useful in high-volume tracking where keyboard entry is too slow and/or inaccurate. Other applications are the tracking of moving items, such as components in PC assembly operations, railroad cars at various locations, and automobile in assembly plants. The general benefits of Bar Code technology in the supply chain environment are: Speeds data entry, Enhances data accuracy, Reduces material-handling labour, Minimizes on-hand inventory, Monitors labour efficiency, Improves customer service, Reduces product recall, Verifies orders at receiving and shipping, Reduces work-in-process idle time, Monitors and controls shop floor activity, Improves shop floor scheduling, Optimizes floor space, and Improves product yield/reduces scrap.

Data Warehouse

Generally, a data warehouse is a decision support tool for collecting information from multiple sources and making these information available to end users in a consolidated, consistent manner. The concept originated in the 1970s, when corporations realized they had many isolated information systems “islands” that could neither share information nor provide an enterprise-wide picture of corporate activities. Recently, there has been a renewed interest in this concept, as organizations adopt distributed computing architectures while they leverage their isolated legacy systems. Rather than trying to develop one unified system or linking all systems in terms of processing, a data warehouse provides a means to combine the data in one place and make it available to all of the systems.

In most cases, a data warehouse is a consolidated database maintained separately from an organization's production system databases. It is significantly different from a design standpoint. Production databases are organized around business functions or processes such as payroll and order processing. Many organizations have multiple databases, often containing duplicate data. A data warehouse, in contrast, is organized around informational subjects rather than specific business processes. The data warehouse, then, is used to store data fed to it from multiple production databases in a format that is readily accessible by end users. Data held in data warehouses are time-dependent, historical data and may also be aggregated.

For example, separate production systems may track sales and coupon mailings. Combining data from these different systems may yield insights into the effectiveness of coupon sales promotions that would not be immediately evident from the output data of either system alone. Integrated within a data warehouse, however, such information could be easily extracted.

One immediate benefit of data warehousing is the one previously described in the example about sales and marketing data. Providing a consolidated view of corporate data is better than many smaller (and differently formatted) views. Another benefit, however, is that data warehousing allows information processing to be off-loaded from individual (legacy) systems onto lower-cost servers. Once done, a significant number of end-user information requests can be handled by the end users themselves, using graphical interfaces and easy-to-use query and analysis tools. Accessing data from an updated information warehouse should be much easier than doing the same thing with older, separate systems. Furthermore, some production system reporting requirements can be moved to decision support systems – thus freeing up production processing.

Internet

In terms of advancement in technology and communications capabilities, perhaps the most influential development over the past decade has been the adaptation of the Internet from strictly government and research applications into the areas of commerce and mass communications. At the most basic level, a network of networks, the Internet provides instant and global access to an amazing number of organizations, individuals, and information sources. Through systems like the popular World Wide Web (the web), Internet users are able to conduct organized searches on specific topics as well as browse various web sites to discover the vast resources available to them through their computer.

The Internet offers tremendous potential for supply chain members to share information in a timely and cost-effective manner, with relative case. Many organizations are now exploring the numerous opportunities provided by the Internet. For example, the Internet provides opportunities for the development of EDI systems. It also provides an incredible source of information about potential suppliers of products and services. A few examples of the type of information available on the Internet are provided under the World Wide Web heading.

Although the potential benefits of supply chain applications on the Internet are substantial, as with any emergent technology, certain issues must be resolved. A key Internet concern is the issue of privacy, the level of security for information. Privacy of information transmitted on the Internet is an issue for all users, particularly in the use of credit-card members and other sensitive information. For supply chain members already struggling with the challenge of freely sharing information, these issues only add to their concerns.

These issues may soon be resolved. Currently, web software called 'merchant' server is in advanced stages of development. Although present applications are being developed to assist with consumer transactions, such as providing secure conduits for payment information and transactions, other applications are not far behind. One approach for such security problems is the development of the supply chain's own Internet.

Intranet/Extranet

Intranets are networks internal to an organization that use the same technology that is the foundation of the global Internet. Many industry analysts expect such corporate networks to provide most of the revenue for computer hardware and software vendors over the next few years as an increasing number of business expand their internal networks to improve efficiency.

By using Web browsers and server software with their own internal systems, organizations can improve internal information systems and link otherwise incompatible groups of computers. Internal networks often start out as ways to link employees to company information, such as lists, product prices, or benefits. Because internal networks use the same language and seamlessly connect to the public Internet, they can easily be extended to include customers and suppliers, forming a supply chain "Extranet" at far less cost than a proprietary network.

World wide Web

The World Wide Web is the Internet system for hypertext linking of multimedia documents, allowing users to move from one Internet site to another and to inspect the information available without having to use complicated commands and protocols.

The implications of the Web for business applications are obvious and far-reaching. Web-based technology and tools have been developed in virtually every industry and forms of commerce. Supply chain functions are no exception. For instance, Enterprise Transportation management was recently launched by Metasys Inc. through the Oracle Web Applications Server; this system deploys a variety of critical information about transportation and distribution applications throughout the supply chain. Further, the system can be accessed with any Java-enabled browser. Access may be controlled through a corporate network, via the Internet or an Intranet Web site.

The number of Web sites relevant to supply chain management is growing at a rapid pace. From specific sites providing information about the capabilities and fees of potential supply chain partners to educational sites developed primarily on reference tools, the number of sites and variety of information available on the Web is impressive. Examples of the Web sites available include the following:

1) **www.con-waynow.com** provides information about the expedited motor-carrier arm of Con-Way Transportation Services, providing information about the company's services, market coverage, and truck fleets, as well as direct e-mail links to Con-Way NOW's sales, operations, and human resources departments.

2) **www.gebn.bus.msu.edu** provides access to Global Procurement and Supply Chain Benchmarking Initiative home page. The Global Procurement and Supply Chain Benchmarking Initiative is a third-party procurement and supply chain benchmarking effort housed in The Eli Board Graduate School of Management at Michigan State University. The primary mission of this group

is to collect and disseminate information concerning the best procurement and supply chain strategies, practices, and processes being employed by companies across a wide range of industries worldwide.

3) **www.supply-chain.com** developed by the Supply Chain Council provides a valuable reference source introducing shippers to the Council's mission and supply-chain reference model, a leading edge benchmarking tool being developed for specific supply chain applications.

Most of the supply chain related professional societies have highly informative home pages. These Web sites typically provide information about the organization's objectives, educational and training opportunities, educational products, reference libraries, job placement services, discussion forums, conferences, and membership requirements.

Decision Support Systems

By the early 1970's the demand for all types of Industrial Software started to accelerate. The increased capabilities and reduced costs justified computerized support for an increased number of non-routine applications. At that time, the discipline of decision support systems (DSS) was initiated. The basic objective of a DSS is to provide computerized support to complex non-routine and partially structured decisions.

At first, the cost of building a DSS prohibited its widespread use. However, the availability of low-cost personal computer around 1980 changed this situation. Desktop PCs, which are easily programmable, made it possible for a person with limited programming ability to build useful DSS applications (e.g., spreadsheets with built-in-macros). This was the beginning of the era of end-user computing. Analysts, Managers, many other professionals, and Secretaries began building their own systems.

Given the complexity of supply chains, development of DSS to assist decision-makers in terms of both the design and operation of integrated supply chains is likely to increase. These DSS will help decision-makers identify opportunities for improvements across the supply chain, far beyond what even the most experienced manager could provide through intuitive insight. Supply chain-wide DSS will allows management to look at the relationships across the supply chain, including suppliers, manufacturing plants, distribution centers, transportation options, product demand, relationships among product families, and a host of other factors to optimize supply chain performance at a strategic level.

Supply chain DSS requires large amounts of both static and dynamic information from the member organizations. The static information includes production rates and capabilities for all supply chain entities, bills of material, routings, and facility preference. The dynamic information includes forecasts, orders, and current deliveries. Using all of this information to solve, for example, a quick-response scheduling problem across the supply chain is virtually impossible with a single technology. However, all the data can be readily obtained from existing information systems through Structured Query Language (SQL) using various relational databases or the *"supply chain data warehouse"* if one exists.

Specific technologies that may be utilized for an effective supply chain management DSS include: SQL interface, Expert system rules, Scheduling algorithms, optimization (Linear programming capabilities), Blocked scheduling, Multisite/multistage scheduling, Graphical user interface, User definable database, Available-to-promise, and Demand management.

Activity 4

Examine the suitability of e-commerce, Electronic Data Interchange and Bar Code System practices of Indian Organizations. For this, refer National/ International Journals or select an organization known to you.

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8.7 SUMMARY

The sharing of information among supply chain members is a fundamental requirement for effective supply chain management. At the ultimate level of integration, decision makers at all levels within the supply chain members organizations are provided with the information they need, in the desired format, when they need it, regardless of where within the supply chain this information originates. Providing the decision-makers within the supply chain with the 'right' information, in the necessary format, and in a timely manner is a major challenge. The information requirements determination approaches presented in this unit have been effective in ensuring that these information requirements are met.

The information systems and the technologies utilized in these systems represent one of the fundamental elements that "link" the organizations of a supply chain. The range of technologies available to support supply chain management efforts is vast and ever changing. Unfortunately, there is not a single "right" IT solution to supply chain management. Organizations need to explore various options to arrive at a solution that provides the functionality required for their specific supply chain management initiative. Towards this end, benchmarking integrated supply chain efforts to identify "best practices" is essential.

Supply Chain Management initiatives are unlikely to succeed without the appropriate information systems and the technology required to support them. These important decisions should be made by a cross-functional, inter organizational management group that can afford to manage the constraints related to the time and resources required to develop a supply chain information systems strategy. The team should implement the strategy, and ever see its ongoing performance.

8.8 SELF-ASSESSMENT QUESTIONS

1) Define Information Technology. What are the advantages and disadvantages of adoption of IT in Indian Manufacturing Organizations?
2) What is the value of information? How would you try to assess the value of information to a decision-maker?
3) Explain briefly the Inter Organizational Information system. How is IOIS important for effective supply chain management?
4) What are the fundamental mistakes commonly made while capturing information? How would these mistakes be eliminated in SCM?

5) Give various supply chain information categories. Give examples of information contained in these categories.

6) What are the major advantages and disadvantages of inquiry systems in which data are captured on-line but files are updated later – say at night?

7) How would you measure the extent of unemployment created by the implementation of IT? What factors tend to mitigate the problem of increased unemployment if it actually occurs?

8) Does IT have an impact beyond the organization, for example, on stockholders or customers? What kinds of effect occur and what problems are created for these groups?

9) What is the IT enabled organization design variables? How do they supplement or replace conventional design variables?

10) What are the risks for a small company connecting itself electronically with major customers?

11) What kinds of employees are most likely to be replaced by Information Technology? Does your answer depend on the type of system? Are the decision levels affected?

12) Write a brief note on the following:

i) Electronic commerce

ii) Electronic Data Interchange

iii) Bar Coding and Scanning

iv) Data Warehouse

v) Internet

vi) Intranet/Extranet

vii) World Wide Web

viii) Decision Support System

13) What are the advantages and disadvantages of using Bar Code and Scanning System in the Manufacturing Organizations?

14) Give a list of potential benefits of using Electronic Data Interchange (EDI). Who are the service providers of EDI in India and their terms and conditions?

15) Compare and contrast EDI, Internet, and Intranet/Extranet. How are they applied in SCM?

8.9 REFERENCES AND SUGGESTED FURTHER READINGS

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