Chapter 1

Introduction to SCM – the central theme of this research

1.1 Introduction to SCM

A supply chain is inherently a group of independent organizations connected through the products and services to deliver them to the end consumer wherein they separately and / or jointly add value for the consumer. It is like an extended boundary of an organization which adds value to its products or services in the process of their delivery to its customers. It is worth finding why managing supply chain is not only becoming necessary and important but unavoidable in success of today’s business or what is the benefit of understanding the value addition from the perspective of supply chain?

Significant changes have taken place in the concept and theory of business management over the past 3 decades since a lot of new ways, ideas or approaches have emerged to take the center stage of the business such as business process re-engineering, lean and agile manufacturing, balanced score card, etc. etc… to name a just few and Supply Chain Management has become the most researched topic.

This research study focuses on the performance of supply chain of a bulk ore export industry in Goa, India after it has been automated and compares with pre-automation era, thereby offering a ready hand comparative analysis of impacts of automation on the efficiency and effectiveness of supply chain, pre and post automation. While the coverage of the topic may appear to be highly technological in first sight, but all efforts have been made to keep the language free from jargons (except where it is must to bring salient features of technology and necessary to explain differentiation from other options) and to make it easily understandable by all readers with varied level of interest. Research from a variety of sources was relied upon to arrive at methodology and in-depth analysis of challenges and benefits across different industries across globe. Most significant challenge as gathered from earlier research was improper planning in synchronization of supply chain and integration of technology in to facilities and software systems, which many times require a tweaking of existing processes and is
attempted under the purview of business process re-engineering. Benefits are numerous, but one has to have an eagle’s eye to spot the difference or impact pre and post implementation, most notable ones across different industry sectors are increased information sharing, thereby increasing product visibility and real-time information for better decision-making. We now touch upon a few important excerpts from past literature to realize the importance of these decisions.

Organizations increasingly realize that they must rely on effective supply chain process networks to compete in the global market. During the past few decades under the demanding globalization and outsourcing environment, many organizations have innovated successfully to operate collaborative supply networks in which each specialized business partner focuses on only a few key strategic activities, leaving the manufacturer to focus and innovate in his own core area of strengths. Holweg et. al. (2005) said that there has to be a common goal while collaborating in the supply chain as to create a visible transparent pattern of demand that drives the entire supply chain. Stephen J. New (1999) argued that SCM is neither a temporary fad nor a parochial arena for the group of specialist researchers. Rather, it is simply the most practical and intellectual theme within present day management and economic research. It is not a new area in any sense; it is just a new label under which diverse research can be conducted.

1.2 The Objective of a Supply Chain

The common objective of any supply chain would be to maximize the overall value generated. The surplus created from supply chain is a value which is equal to what is worth of final product to the customer less the costs the supply chain incurs in fulfilling the customer’s need. For most business supply chains, the surplus from supply chain will always be linked to the profitability of supply chain, i.e. the revenue earned from the customer less the costs across the supply chain. A portion of the supply chain surplus is shared with the customer and the balance is held back as profit with the supply chain. The difference represents the supply chain profitability as the residual left out from the price after deducting the sum total of all costs incurred by the supply chain to produce and distribute the product for which the customer paid. Supply chain profitability is the
total profit to be shared across all supply chain stages and intermediaries. The higher the profitability of supply chain, the more successful would be the supply chain. Effective supply chain management comprises of management of the assets and products, information, and fund flows of supply chain to maximize total supply chain surplus.

1.3 The Importance of Decisions in Supply Chain

There are close linkages between the design and management of supply chain flows (product, information, and funds) and the success of a supply chain. There are examples of companies (Wal-Mart, Dell Computer, and 7-Eleven Japan), who have built their success on superior design, planning, and operation of their supply chain. In contrast, the failure of many e-business such as Webvan can be attributed to weaknesses in their supply chain design and planning.

Hence any business entity which aspires to business excellence journey cannot do it just by inward looking approach alone, rather has to adopt better management practices along with the supply chain leadership through proper strategic positioning, collaboration, integration and appropriate structural configuration. Business value creation is always a collective contribution from everyone involved in supply chain. The reasons for adopting such an approach are not stemming from the theories or reasoning, rather it is demonstrated by customer results and performance improvement measured for the business. The tangible advantages and results that it delivers, makes the subject of supply chain so important.

1.4 Stages of Supply Chain

A typical supply chain involves a variety of stages. These supply chain stages may include:

- Manufacturers
- Component / raw material suppliers
- Wholesalers / distributors
Retailers

Customers

1.5 Process Views of a Supply Chain

Any supply chain is a series of processes and flows which are combined within and between different stages of supply chain to fill a customer need for a product or service. There are two different school of thoughts to view the processes performed in a supply chain:

**Cycle View**: It assumes that the processes in a supply chain are broken into a series of cycles, being performed at the boundary interface between two consecutive stages of a supply chain.

**Push / Pull View**: This school of thought describes supply chain into two categories i.e. whether they are performed in response to a customer order or in anticipation of customer orders. Pull processes are initiated by a customer order, whereas push processes are initiated and performed in anticipation of customer orders.

1.6 Cycle View of Supply Chain Processes

Considering the above five stages of supply chain, all supply chain processes can be described into the following four distinct process cycles:

- Customer order cycle
- Replenishment cycle
- Manufacturing cycle
- Procurement cycle

The figure below is drawn to explain the combined view of process cycles with stages of supply chain, to explain how each cycle involves which all stage of a typical manufacturing supply chain.
1.7 Processes of Supply Chain

There are three Macro Processes which manage the product, flow of information, and funds required to create, receive, and fulfill a customer request. These are CRM, ISCM and SRM as explained below in greater details. The purpose of CRM macro process is to create customer demand and facilitate the placement and tracking of orders. The end purpose of ISCM macro process is to fulfill demand created by the CRM process in a time-bound manner at the minimum possible cost. The purpose of SRM macro process is to scout for and manage supplier sources for various goods and services. SRM processes include the whole gamut of activities comprising of suppliers’ evaluation and selection, supply terms’ negotiation, communicating about new product and orders with suppliers, sharing of demand info and supply plans with suppliers, and placing of replenishment orders. The Global Supply Chain Forum defines eight important processes that comprise the heart of supply chain management:

- Customer Relationship Management
- Customer Service Management
- Demand Management
• Order Fulfillment
• Manufacturing Flow Management
• Procurement
• Product Development and Commercialization
• Returns

The eight important business processes run the length of the supply chain and cut across firms and functional silos within each firm. Functional silos include Finance, Production, Purchasing, Marketing, Logistics, Research and Development. The supply chain includes the manufacturer, suppliers, transporters, warehouses, retailers, and even customers themselves. In any organization, e.g. a manufacturer, the supply chain includes all functions involved in receiving and filling a customer request. These functions include, but are not limited to new product development, marketing, operations, distribution, customer service and finance.

CUSTOMER RELATION MANAGEMENT (CRM)

The CRM macro process consists of all processes that lie between an enterprise and its customers in the supply chain. The objective of the CRM macro process is to create customer demand and enable transmission through tracking of orders. Any deficiency in this process may result in loss of demand and a poor customer experience, since orders are not being executed effectively. The key processes under CRM are as follows:

Marketing: Marketing processes involve decisions such as which customers to target; how to target customers, what products to offer, how to price the products, and how to manage the actual campaigns targeting customers. A lot of software vendors are promoting CRM analytics that improve the marketing decisions on pricing, product profitability, and customer profitability, among other functions.

Sell: The sell process focuses on making an actual sale to a customer (compared to marketing, wherein processes are more focused on planning who to sell to and what to
sell). The sell process provides the sales force the information it needs to make a sale and then execute the actual sale. The salesperson or the customer, for executing the order may require to build and configure orders by choosing among a variety of options and features. The ability to access information related to a customer order and quote due dates are the common needs while foreseeing about automation, configuration, and personalization to improve the sell process is the critical need of system.

Order management: The process of managing customer orders as they flow through an organization is important for the enterprise to plan and execute order fulfillment, while enabling the customer to track his order. This process matches demand from the customer with supply from the enterprise. Order management software has conventionally been handled by legacy systems or been a part of an ERP system. A number of new order management systems are launched in market place with add-on functionality that enables visibility of order execution across numerous order management processes that exist within a company.

Call / service center: A call / service center is often the primary point of contact between a company and its customers. A call / service center helps customers in placing orders, suggesting products, solving problems, and providing information for order status. All smart and successful software providers have helped improve call / service center operations by often allowing the customers to do the work themselves, thus facilitating and reducing work done by customer service representatives.

Sourcing, Procurement and Supply Management

Commonly, though quite mistakenly referred to as supply chain management, these functions arose in the area of purchasing which came to occupy a predominant position in business because of the impact these had on cash flow and contribution they made to the company profitability. Business realized that efforts required to increase profits through increasing sales were far greater than those involved in generating equivalent returns through reduction in procurement price. Major purchases came to be handled by the top management who in turn depended upon purchase specialists for advice. Economic buying was seen to be a strategic function, with major contribution to bottom-
The responsibilities of the purchase function, however, ended with the procurement where from more mundane functions of materials management took over. We may, thus, regard it as the set of activities, functions, and processes concerned with economic procurement and inflow of inputs into the enterprise and an efficient control over flow of funds out of the company.

Materials Management

Classic materials management included the function of forecasting, inventory management, stores management, warehousing, stock keeping and scheduling till it came to include production planning and production control to evolve into extended materials management. With subsequent inclusion of order processing in its fold, it came to be known as integrated materials management.

Logistics and Distribution

This is the focused area of this research and one dimension of this research is to attempt on automation of all underlying processes contributing to the performance for export of the cargo involved. Hence before we dwell into the specific topic of this research, let us discuss the theoretical base of the topic.

Derived from military parlance, wherein it covered all functions related to movement and maintenance of armies, the logistics function in its business application came to be recognized as time-and space-related placement of goods to provide improved customer service. As per the Council of Logistics Management, Logistics is that part of the supply chain management process which is responsible for planning, implementing, and controlling the efficient and effective flow and storage of goods in either direction, forward or return. related to information between the point of origin and the point of consumption in order to meet customers’ requirements.” The distribution function, which Peter Drucker, identified as the “Today’s Frontier”, is in that sense, synonymous with Logistics.

As Raubenheimer A.L.V. and Conradie P.J., (2002) opined that many a wars have been won and lost through strengths and capabilities of logistics and strangely Generals and
Commanders were aware of the critical role of logistics even before logistics was defined by researchers. One of the first indication of how complex logistics could be, emerged as early as 1915 when Arch Saw wrote that the correlation between the activities of demand creation and physical supply illustrate the existence of the two principles of inter-dependence and balance. Any failure with target department to coordinate any one of these activities or undue emphasis or budget outlay put upon any one of these activities, is bound to disturb the balance of forces driving efficient distribution. The physical distribution of goods is a different from the creation of demand… A no. of distribution failures in past have been due to poor coordination between demand creation and physical supply… the supply must be made first before the distribution work could even begin.

In the context of supply chain management, logistics would fall at both ends, that is, inbound logistics and outbound logistics. Interestingly, the intra-company flow of materials is sometimes referred to as manufacturing logistics, giving this discipline a breadth of reach over end-to-end movement of materials at all stages of industrial and business endeavor in delivering value to customer. Transportation refers to the movement of product from one location / point in space to another as it makes its way from the beginning of a supply to the customer. Transportation is an inevitable and important supply chain driver because it is very rare that products are produced and consumed in the same location. Transportation also consumes a significant component of the costs incurred by the most supply chains. International trade is growing with more and more world’s economic activity moving to competitive locations, usually away from their consumption centers. The growth in international merchandize trade was more than three times the growth of the U.S. economy over between 1970 and 2001. U.S. international merchandize grew by over 20 times, whereas the U.S. economy grew about 10 times over the same period.

1.8 Importance and Complexity of Transportation / Logistics Process

However it took further 70 years or so before the basic principles of logistics management were clearly defined. One of the first definitions came from Martin Christopher who defined logistics as follows:
“Logistics is the process of strategically managing the procurement, movement and storage of materials, parts and finished inventory (and related information flows) through the organization and its marketing channels in such a way that current and future profitability are maximized through the cost-effective fulfilment of orders."

The role of transportation is even more significant in global supply chains. Dell currently has suppliers worldwide and sells to customers all over the world from just a few plants. Transportation allows products to move across Dell’s global network. Similarly, global transportation allows Wal-Mart to sell products manufactured all over the world in the United States.

7-Eleven Japan is another firm that has used transportation to achieve its strategic goals. The company has a goal of carrying products in its stores to match the needs of customers as they vary by geographic location or time of day. To help achieve this goal, 7-Eleven Japan uses a very responsive transportation system that replenishes its stores several times a day so that the products available match customers’ needs. Products from different suppliers are aggregated on trucks according to the required temperature to help achieve very frequent deliveries at a reasonable cost. 7-Eleven Japan uses a responsive transportation system along with aggregation to decrease its transportation and receiving costs while ensuring that product availability closely matches customer demand.

To understand transportation in a supply chain context, it is important to consider the perspective of all four parties, including supplier and customer. A carrier makes investment decisions regarding the transportation equipment (locomotives, trucks, airplanes, etc.) and in some cases infrastructure (rail), and then makes operating decisions to try maximize the return from these asserts. A shipper, in contrast, uses transportation to minimize the total cost (transportation, inventory, information, sourcing, and facility) while providing an appropriate level of responsiveness to the customer.

We can think of a transportation network as a collection of nodes and links. Transportation originates and ends at nodes and travels on links. For most modes of transportation, infrastructure such as ports, roads, waterways, and airport is required
both at the nodes and links. Most transportation infrastructure is owned and managed as a public good throughout the world. It is very important that infrastructure be managed in such a way that monies are available for maintenance and investment in further capacity as needed. Transportation policy sets direction for the amount of national resources that go improving transportation infrastructure. Transportation policy also aims to prevent abuse or monopoly power, promote fair competition and balance environmental, energy, and social concerns in transportation.

MODES OF TRANSPORTATION AND THEIR PERFORMANCE CHARACTERISTICS

- Air
- Package carriers
- Truck
- Rail
- Water
- Pipeline
- Inter-modal

TRANSPORTATION INFRASTRUCTURE AND POLICIES

Roads, seaports, airports, rail, and canals are some of the major infrastructural elements that exist along nodes and links of a transportation network. In almost all countries, the government has either taken full responsibility or played a significant role in building and managing these infrastructure elements. Even in the United States, where a lot of the rail infrastructure was built by private capital under a charter, the cost was subsidized through land grants from the government. Improved infrastructure has played a significant role in the development of transportation and the resulting growth of trade. More recently, the impact of improved road, air, and port infrastructure on the development of China is very visible.
Transportation infrastructures often require government ownership or regulation because of its inherently monopolistic nature. In the absence of a monopoly, deregulation and market forces are an effective mechanism. When the infrastructure is publicly owned, it is important to price usage to reflect the marginal impact on the cost to society. If this is not done, overuse and congestion result because the cost borne by a user is less than his or her marginal impact on total cost.

DESIGN OPTIONS FOR A TRANSPORTATION NETWORK

Direct Shipment Network

With the direct shipment network option, the buyer structures his transportation network so that all shipments come directly from each supplier to each buyer location. With a direct shipment network, the routing of each shipment is specified and the supply chain Manager only needs to decide on the quantity to ship and the mode of transportation to use. This decision involves a trade-off between transportation and inventory costs.

The major advantage of a direct shipment transportation network is the elimination of intermediate warehouses and its simplicity of operation and coordination. The shipment decision is completely local, and the decision made for one shipment does not influence other. The transportation time from supplier to buyer location is short because each shipment goes direct.

All Shipment via Central Distribution Center

Under this option, supplier do not send shipments directly to buyer locations. The buyer divides locations by geographic region and a DC is built for each region. Suppliers send their shipments to the DC and the DC then forwards appropriate shipments to each buyer location.

The DC is an extra layer between suppliers and buyer locations and can play two different roles. One is to store inventory and the other is to serve as a transfer location. In either case, the presence of DCs can help reduce supply costs when suppliers are located far from the buyer locations and transportation costs are high. The presence of a DC allows a supply chain to achieve economies of scale for inbound transportation to
a point close to the final destination, because each supplier sends a large shipment to the DC that contains product for all locations the DC serves. Because DCs serve locations nearby, the outbound transportation cost is not very large.

TRADE-OFFS IN TRANSPORTATION DESIGN

All transportation decisions made by shippers in a supply chain network needs to take into account their impact on inventory costs, facility and processing costs, the cost of coordinating operations, as well as the level of responsiveness provided to customers. For example, Dell’s use of package carriers to deliver PCs to customers’ increases transportation cost but allows Dell to centralize its facilities and reduce inventory costs. If Dell wants to reduce its transportation costs, the company must either sacrifice responsiveness to customers or increase the number of facilities and resulting inventories to move closer to customers.

The cost of coordinating operations is generally hard to quantify. Shippers should evaluate different transportation options in terms of various costs as well as revenues and then rank them according to coordination complexity. A manager can then make the appropriate transportation decision. Managers must consider the following trade-offs when making transportation decisions:

Transportation and inventory cost trade-off

Transportation cost and customer responsiveness trade-off

When selecting a mode of transportation, managers must account for cycle, safety, and in-transit inventory costs that result from using each mode. Modes with high transportation cost can be justified if they result in significantly lower inventory costs.

INVENTORY AGGREGATION

Firms can significantly reduce the safety inventory they require by physically aggregating inventories in one location. Most e-business use this technique to gain advantage over firms with facilities in many locations. For example, Amazon.com has focused on decreasing its facility and inventory costs by holding inventory in a few
warehouses, whereas booksellers such as Borders and Barnes & Noble have to hold inventory in many retail stores.

Transportation cost, however, generally increases when inventory is aggregated. As the degree of inventory aggregation increases, total transportation cost goes up. All firms planning inventory aggregation must consider the trade-offs among transportation, inventory, and facility costs when making this decision.

**RISK MANAGEMENT IN TRANSPORTATION**

There are three main types of risk to consider when transporting a shipment between two modes on the network:

- The risk that the shipment is delayed
- The risk that the shipment does not reach its destination because intermediate nodes or links are disrupted by external forces
- The risk of hazardous material

In each case it is important to identify the sources of risk and their consequences and plan suitable mitigation strategies.

Delay arises either because of congestion along links such as roads or nodes such as ports and airports. When congestion is the cause of delay, mitigation strategies for the shipper include moving inventories closer to the destination, using alternative lanes, and building a buffer into the lead time. Congestion delays can be mitigated by designing a network with multiple routes to the destination and changing routes based on congestion. Congestion delays can also be mitigated through the use of congestion pricing by the owner of the transportation node or link. Delay may also arise because of the limited availability of transportation or infrastructure capacity. Such delays are more likely when the assets are owned by a third party that is serving multiple customers. These delays may be mitigated by owning some transportation capacity or by signing long-term contracts for transportation capacity with the third party.

**1.9 Supply Chain Definitions:**
Archibald defines SCM as achieving a sustainable competitive advantage, maximizing shareholder value and optimizing the relationship of process, information, and physical goods among internal and external trading partners.

As we can see in the Supply Chain Management process, all the activities are interconnected with each other. Therefore, for a smoother process flow, these activities should be clearly defined and all of them should have a proper Standard Operating Procedure, which ensures their smoother running. Supply Chain Management is a set of activities through which we can arrange and integrate the stakeholders of the Supply Chain process. One needs to understand the 4 intrinsic flows of a supply chain to apprehend the boundary and function of a supply chain, otherwise the very nature of supply chain is so pervasive. These flows are:

**Material Flow:** Any manufacturing supply chain would have material flows from the raw materials (the beginning of supply chain) to the finished products at the end of supply chain. It is uni-directional.

**Information Flow:** all supply chains have information flows and there are multiples of information flows such as demand forecasting, production and design flows, scheduling information flows, Sales information flows, etc. The information flows can run both directions, upstream and downstream, unlike material flows, which are unidirectional as well as are unique to that particular product.

**Finance Flow:** It is also known as blood flow in common parlance and basically is money flow. For any supply chain, there is only one common single source of such finance flow, i.e. end-consumer. The sharing and distribution of the finance resource in a fair manner across its partners would ensure better alignment between the participating companies.

**Commercial Flows:** All supply chains represent a transactional commercial flow. The transactional process of buying and selling enables moving of material flows' ownership from the supplier to the buyer repeatedly until the end of the supply chain-the end consumer. Such transactional commercial flow would take place only in a supply chain
where there are more than one partner companies, else no commercial flows take place in a tightly integrated manufacturing supply chain.

1.10 History and evolution of SCM—Development trends

The earliest use of the term ‘supply chain management’ as is known today, can be traced back to literature of early 1980s, more precisely in 1982, it was first coined in a Financial Times article written by Keith Oliver, a consultant at Booz Allen Hamilton and Weber explaining the gamut of activities required in procurement and managing supplies in an organization. It gained currency in the mid-1990s, when a flurry of articles and books came out on the subject. However with passage of time, the major development and quantum increase in publications on the topic as we know today, has helped establish the academic and industrial relevance of supply chain management.

It is thus not one of the legacy academic subjects that existed for hundreds of years, but rather a nascent and newer subject, that the business world has started using now. The next obvious question therefore is “why now”? The fact that business environment has changed due to a no. of factors, including globalization, not to name equally transformational factors like cut-throat competition, ever-increasing customer expectations, geo-political influences and technological innovations. Under such challenging business environment, an organization-focused approach alone would not suffice to deliver the required competitiveness. Managers have therefore understood that their business is only just one part of the supply chain and it is finally the supply chain that wins or loses the competition.

The landscape of competition is shifting from ‘organization against organization’ to ‘supply chain against supply chain’. The winner in today’s business is one who not only knows how to compete, but also has the ability to cooperate within the supply chain. The new mantra in business ‘One would sink or swim with the supply chain’, has made supply chain the omnipotent and ubiquitous in business.

During the period that followed, businesses tried to deal with this new concept of chain by breaking it down in to pieces, rigging up walls between segments of the chain, thus fragmenting the responsibilities, using different tools to track these pockets of data. This
led to inability of the managers involved with supply chain to see ‘the bigger picture’ of decisions taken and resulting impact on the bottom line. In other words businesses needed something more than just a localized view, i.e. need of viewing it on a global scale. This gave rise to the pressing demands of supply chain integration.

**The First Revolution (1910-1920): The Ford Era**

The first major revolution was started by the Ford Motor Company where they demonstrated a tightly built integrated chain. Of course Ford Motor Company had owned every part of the chain- right from the timber to rails. It could manage the entire journey from iron ore mine to the finished automobile in 81 hours flat, through its rigid yet efficient chain. It could not handle a wide product variety and hence was not sustainable in the long run as General Motors, on the other hand, offered wider variety of models and colors, resulting in Ford carrying a huge pile up of inventory in the chain. Till this point in time, almost all automobile manufacturers were highly integrated firms, making the bulk of the parts by themselves.

**The Second Revolution (1960-1970): The Toyota Supply Chain**

Towards the end of the first revolution, the industry witnessed many path-breaking changes, especially a trend towards wider product variety which forced the industry to build flexible yet efficient supply chains, without holding excess inventory of a wide variety of products. The Toyota Motor Company demonstrated this, thus triggering the second revolution. The Toyota Motor Company had set up just the final assembly lines and in-house manufacturing of only key components, thus outsourcing a bulk of its components to a large no. of suppliers, located very close to its own assembly-lines. This facilitated low set-up times to accommodate variety in its models, without having to increase inventory or costs. The key feature of such inter-dependence with a no. of suppliers was weaving of long-term relationships with them through inter-locking shareholdings under so called *keiretsu* system. However Toyota and other Japanese forms soon realized that they would have to take their suppliers also along with them, when they tried to set up assembly lines in different parts of the world for fuelling their further growth. Thanks to advent of electronic data interchange (EDI), it was possible
now to integrate with their suppliers without forcing them to locate their plants close to the assembly plant.

In the course of time, the Toyota supply chain also had developed certain rigidities, such as a permanent relation with suppliers, which posed the threat to become a liability over a period of time. This, in turn, led to the third revolution led by Dell Computers, which offered its customers the ultimate luxury of customization with loosely held supplier networks.

**The Third Revolution (1995-2000): The Dell Supply Chain**

Thanks to advancements in Information technology (IT), Dell Computers allowed their customers to configure their own PCs and track the same in their production and distribution systems. The information technology thus gave huge power in the hands of customer to choose and configure their products the way they liked it. This also made the supply chain virtually compressed to such thin level that the whole seller – dealer – retailer chain virtually became absent and this gave rise to e-business or so called e-tail. Today the e-business is fastest growing business, defying the recessionary trends which the other forms of business have been witnessing. Many new lines of business models or products are becoming popular, which hitherto have been unheard of. Let us take for example the case of a customer who makes an online purchase of a computer from Dell Computer, the supply chain would include Dell’s Web site, the Dell assembly plant and all of Dell’s suppliers and their suppliers, and finally the customer. The Web site provides the customer with information regarding pricing, product variety and product availability. Having made a product choice, the customer enters the order information and pays for the product. The customer may later return to the Web site to check the status of the order. Stages further up the supply chain use customer order information to fill the request. This whole process involves additional flow of information, product and funds between various stages of the supply chain.

1.11 **INFORMATION TECHNOLOGY IN A SUPPLY CHAIN**

Information is a key chain driver as it acts as a binder for the other supply chain drivers to work together with the aim of creating a coordinated integrated supply chain.
Information is critical to performance of supply chain because it lays the foundation upon which supply chain processes transacts and enables managers to take decisions. Without information, a businessman does not know what his customers want, how much stock of products are to know when further shipment of product(s) should be produced or made. In short, without information, a manager is just blind to the reality of business and can make wrong decisions. Therefore information makes the supply chain visible to a manager. A manager can make right decisions with this visibility to improve the supply chain’s performance.

To understand the role of information in the success of a supply chain, it is important to understand how information is collected and analyzed. This is where information technology comes to its importance. IT comprises of the hardware, and software through the people in a supply chain who collect and execute certain programs to seek necessary vital pieces of information. IT can be termed as the eyes and ears (and even as part of the brain) of management in a supply chain, so as to capture and analyze the right kind of information, a must for making a good decision. E.g. A manager in car manufacturing company would need to know how many engines and gear boxes are available in stock currently to produce that many vehicles. Information Technology is also used to analyze the information and recommend an action. In this role, the IT system would look at demand forecasts, then the number of components available in inventory per the bill of materials so as to suggest whether to order more components from its suppliers. The information to be useful while making supply chain decision, must have following characteristics:

Information must be accurate: It is very difficult to make good decisions without such information that gives a true picture of the state of the supply chain. It is not that all information must be 100 percent correct, but at least the data should be able to paint a picture that is at least directionally correct.

Information must be accessible in a timely manner: Most often than not, accurate information exists, but by the time it is available, it is either out of date or, even if it is current, it is not in an accessible form. A manager needs to have up-to-date information that is easily accessible to make good decisions.
Information must be of the right kind: Decision makers need information that they can use. Many times companies have large amounts of data that is not helpful in making a decision. Companies must think about what information should be recorded so that valuable resources are not wasted collecting meaningless data while important data goes unrecorded.

Information must be shared: A supply chain can be effective only if all stakeholders within the supply chain share a common view of the information that they use to make business decisions. Different information with different stakeholders results in misaligned actions, affecting supply chain performance.

Managers need to be able to understand how to analyze information to make good decisions. Information is a key ingredient not just at each stage of the supply chain, but also within each phase of supply chain decision making – from the strategic phase to the planning phase to the operational phase. For example, information and its analysis play a significant role during the formulation of supply strategy by providing the basis for decisions such as the location of the push / pull boundary of the supply chain. Information also plays a key role in the planning process, in operational decisions such as what products will be produced during today’s production run.

Information is used when making a wide variety of decisions about each of the supply chain drivers, as discussed here below.

Facility: Determining the location, capacity, and schedules of a facility requires information on the trade-offs among efficiency and flexibility, demand, exchange rates, taxes, and so on. Wal-Mart’s suppliers use the demand information from Wal-Mart’s stores to set their production schedules. Wal-Mart uses this information to determine where to place its new stores and cross-docking facilities.

Inventory: Setting optimal inventory policies requires information that includes demand patterns, cost of carrying inventory, costs of stocking out, and costs of ordering. For example, Wal-Mart collects detailed demand, costs and margins besides supplier information to make those inventory policy decisions.
Transportation: Deciding on transportation networks, routings, modes, shipments, and vendors requires information including costs, customer locations, and shipment sizes to make good decisions. Wal-Mart uses information to rightly integrate its operations with those of its suppliers. This integration allows Wal-Mart to implement cross-docking in its transportation network, saving on both inventory and transportation costs.

Sourcing: Information on product margins, prices, quality, delivery lead times, and so on, are all important in making sourcing decisions. Given sourcing deals with enterprise transactions, there is also a wide range of transactional information that must be recorded in order to execute operations, even once sourcing decisions have been made.

Pricing and revenue management: To set pricing policies, one needs information on demand, both its volume and various customer segments’ willingness to pay, as well as many supply issues such as the product margin, lead time, and availability. Using this information, firms can make intelligent pricing decisions to improve their supply chain profitability.

In summary, information is crucial to making good supply chain decisions at all three levels of decisions making (strategy, planning, and operations) and in each of the other supply chain drivers (facilities, inventory, transportation, sourcing, and pricing). IT enables not only the gathering of these data to create supply chain visibility, but also the analysis of these data so that the supply chain decisions made will maximize profitability.